

THE**NEW**

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SCIENTIST

Special Harvey Tercentenary Articles

WILLIAM HARVEY'S LIFE AND WORKA. Dickson Wright, M.S., F.R.C.S.,
President of the Tercentenary Congress**RECENT CLINICAL RESEARCH ON THE
HEART AND CIRCULATION**

Professor John McMichael, M.D., F.R.C.P., F.R.S.

NEW REMEDIES FOR STREET CONGESTION

by Sir John Elliot, Chairman, London Transport Executive

THE "CLEAN" HYDROGEN BOMB

by John Maddox

THE EARTH'S INCREASING DESERTS

by Dr. J. L. Cloudsley-Thompson

NOTES AND COMMENTS

We have too few tunnels

ONE of the mysteries of civil engineering is why, as soon as a road has been resurfaced, men come along with pneumatic drills to dig trenches in it. The disruption to traffic due to repairs and relaying of underground cables and pipelines is very great. It can be avoided by putting these services in tunnels or subways.

But tunnelling is expensive and slow. Its high cost has prevented the building of a new tube line in central London which would do much to relieve rush hour traffic. It has also delayed the excavation of many tunnels under rivers and estuaries which are now badly needed.

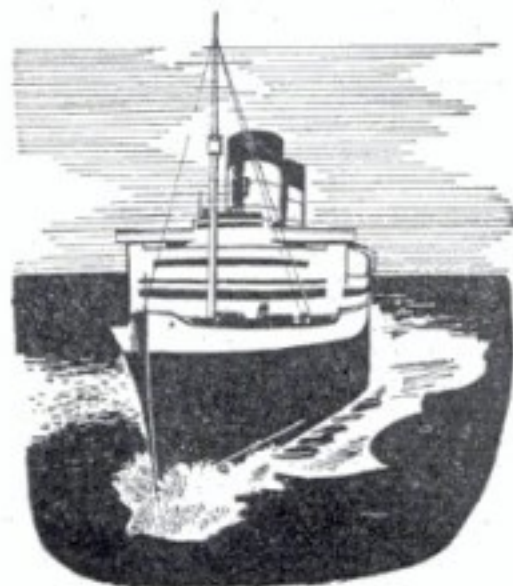
One of the reasons for the high cost of tunnel-building is that the excavation is carried out by hand, or with the help of pneumatic tools. The earth which is displaced is carried back and dumped outside the tunnel.

Recently some slight advance has been made through the import of boring machines from the United States by Costain-John Brown. One of these machines is at present at work boring a two-foot diameter hole for a drainage sewer underneath the main railway line at Staines. The borer uses a cutting tool rotated by an engine mounted outside the boring, and a scroll conveyer which brings the displaced earth back to the workings. Such machines are able to bore holes up to about 200 ft. in length and 3 ft. 6 inches in diameter.

Useful as it is to be able to make holes of this size through earth and clay without either trenching and covering or using conventional tunnelling techniques, the limitations of the machine are obvious. The Russian "mechanical mole" (see *The New Scientist*, 13 December, p. 20) not only bores a much larger tunnel but obviates the need to dispose of large quantities of "spoil," and places the source of power close to the cutting tool.

There could be many uses for tunnelling machines in Britain—in constructing service tunnels under roads, hydroelectric waterways, underground gasification schemes, sewers and possibly even the bigger tunnels needed for tube trains, road traffic and colliery haulage ways. But the construction of such a machine requires basic research on the cutting of rock and earth. Who is to do this work? At the moment there appears to be nobody undertaking it. The prizes are rather too remote for any but the largest industrial firms to consider it.

The project is one which might well receive Government patronage through the Mechanical Engineering Research Laboratory at East Kilbride—or private sponsorship through the oil companies, which are of course greatly interested in finding the quickest (and cheapest) way of drilling boreholes.



Replacing the "Queens"— a difficult decision

THE new Cunard passenger liner *Sylvania* sailed this week on her maiden voyage to Canada. She is the last of a group of four sister ships which have been built in the past few years for the company's Canadian service. The start of her maiden voyage came only a few days after the announcement of the placing by the Cunard company of an order for another ship for the Atlantic crossing.

A little further south, running between Southampton and New York in the company's main route to the United States, the *Queen Mary* and *Queen Elizabeth* are approaching the age where their replacement will have to be undertaken.

The enormous size and high speed of these ships makes speculation about their successors a fascinating business. Will they be as big as the *Queens*? Will use be made of atomic power for their machinery? Will the cost of construction of ships of this sort be beyond the capacity of the shipowners?

NOTES AND COMMENTS *continued*

At present there are probably only two British yards capable of building a ship the size of the *Queens*, though by the time that a keel has to be laid there will almost certainly be others, since a number of shipyards are increasing the size of their building berths to accommodate giant tankers. But in fact, there is no certainty that replacement ships would be of the same size as the *Queens*.

Large size would, of course, be a definite advantage if atomic power were being considered for these ships, as ships needing high powers will also need ample space available for the reactor and its shielding. In making this decision the Cunard Company will have to consider how soon it has to take the plunge one way or the other. Economic reactors for even the largest sizes of ship are not likely to be available for some years yet, while for a passenger liner—as opposed to a giant tanker—the question of public confidence must be carefully considered.

The *Queen Mary*, which is the older of the two *Queens*, has recently been fitted with ship stabilisers. The willingness of the Cunard company to finance the purchase and installation of this equipment has generally been taken as showing that the idea is to run the ship for at least five to seven more years.

She could probably be run for longer if required, for the two ships were conservatively designed and have been very carefully looked after, despite their strenuous war service. In time they will undoubtedly become uneconomic to run: but it must be remembered that while technical advances make new ships more economical to run, inflation over the period since the *Queens* were built has increased capital charges and depreciation many times.

The tremendous prestige value of the contract for the replacement ships may mean that a berth will be found for them rather more quickly than the length of shipbuilding order books might indicate. Nevertheless they will take three or four years to build, and before long the Cunard company will have to decide on the main features of the design and the number of ships to be built. It will be the most difficult decision of its sort that has yet faced a shipowning firm.

Harvey and the Wellcome Foundation

ONE of the most striking features of the Harvey Tercentenary celebrations is the exhibition of his life and work which opened on Tuesday at the Wellcome Historical Medical Library in Euston Road, London. The exhibition is open to the public.

The Library has become famous for staging exhibitions which give a broad picture of their subject and place it in historical perspective. This has been the case with the Harvey exhibition, which not only includes what is probably the finest and most extensive collection of his works, but also shows how his discoveries were taken up and developed by others. The original works include *De Motu Cordis*, in which the theory of the circulation of the blood was first printed, and the less well known, but perhaps even more fascinating *De Generatione Animalium* in which Harvey outlined his observations on embryology and obstetrics. Harvey had originally become interested in the subject about 1616, but it was not until 1650 that George Ent persuaded him to hand over the manuscript for publication. Harvey, remembering the fate of Vesalius, the Paduan anatomist, must have realised the risks involved in the publication of such a work.

The exhibition contains few personal relics apart from Harvey's will, which shows the reason why. His library, his best Persian carpet and numerous other personal belongings were bequeathed to the Royal College of Physicians, to be lost only nine years later in the Great Fire of London.

The Historical Medical Library is one of the many valuable offshoots of the Wellcome Foundation. The report of the Trust which governs the Foundation has just been published. This is its first report since it was established twenty years ago, and it has an impressive story to tell.

The Trust was set up under the will of Sir Henry Wellcome, who, after the death of Silas Mainville Burroughs, became sole proprietor of Burroughs, Wellcome, the pharmaceutical manufacturers. It administers funds derived from the company which are used for charitable purposes — mostly connected with

medicine. Its chairman is Sir Henry Dale; and its five members act, in effect, as sole shareholders—but shareholders who must see that the profits are spent as Wellcome would have wished.

So far they have disposed of £1,170,164. The greatest part, nearly three-quarters of a million, has been spent on medical and veterinary research. They have also spent £313,883 on medical research museums and libraries, £64,053 on research in the history of medicine, £48,335 completing Sir Henry Wellcome's archaeological enterprises and £4,105 on medals and prizes.

The building in Euston Road where the Harvey exhibition is housed is the centre of all this activity. Besides the Historical Medical Library it contains the Museum of Medical Science and the Laboratories of Tropical Medicine, which was another of Wellcome's own special interests. Indeed it is remarkable how far the vigorous influence of this chemist from Wisconsin still pervades the Foundation.

War among the long-range missiles

ANYONE with a taste for mythology would think it only appropriate that Jupiter should take precedence over Thor, but in all other respects the fact that it was a United States Army ballistic missile and not an Air Force one that was successfully launched last Friday is a reversal of the normal order of priorities.

The Jupiter missile has in some ways an odd history. It has been designed largely by Dr. Wernher von Braun, inventor of the V2, who moved to the United States after the war with several of his Peenemunde design staff. He went to work at the Army's Redstone Arsenal where he was commissioned to develop a long-range bombardment missile out of the V2. This was known for several years as Redstone, and its range was about 400 miles. A large part of von Braun's spare time was spent studying space travel.

When the U.S. Government decided to make an all-out effort to develop long-range guided weapons it had to settle which service was to be respon-

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OUR RAILWAYS ARE IN A RUT

Improvements in oil prospecting : by Dr. Tom Gaskell

Is there an antidote to age? : by Dr. Peter Alexander

RUSSIA'S "MECHANICAL MOLE"

a remarkable earth-tunnelling engine described and illustrated

Mental epidemics : by Dr. F. Kräupl Taylor

How food is preserved : by H. D. Turner

Home and foreign science news : American newsletter

Book reviews : Science crossword : Careers guide

ONE SHILLING WEEKLY

RUSSIA'S MECHANICAL MOLES

To improve methods of tunnelling underground, Soviet scientists employed X-ray photography to study the mole's techniques of burrowing. The lessons have been adapted to man-driven machines

by a STAFF WRITER

MANY civil engineering jobs involve tunnelling—small tunnels to carry gas, water-mains or sewers; or larger ones to contain underground railways, or to carry water to hydro-electric stations.

But tunnelling is a slow and expensive operation.

Most tunnels are made by manual labour, usually with the help of some device like a tunnelling shield. In many cases, where the tunnel is only just beneath the surface, it is possible to "cut and cover"—to dig a deep trench and roof it over. This is how the Toronto tube railway was made.

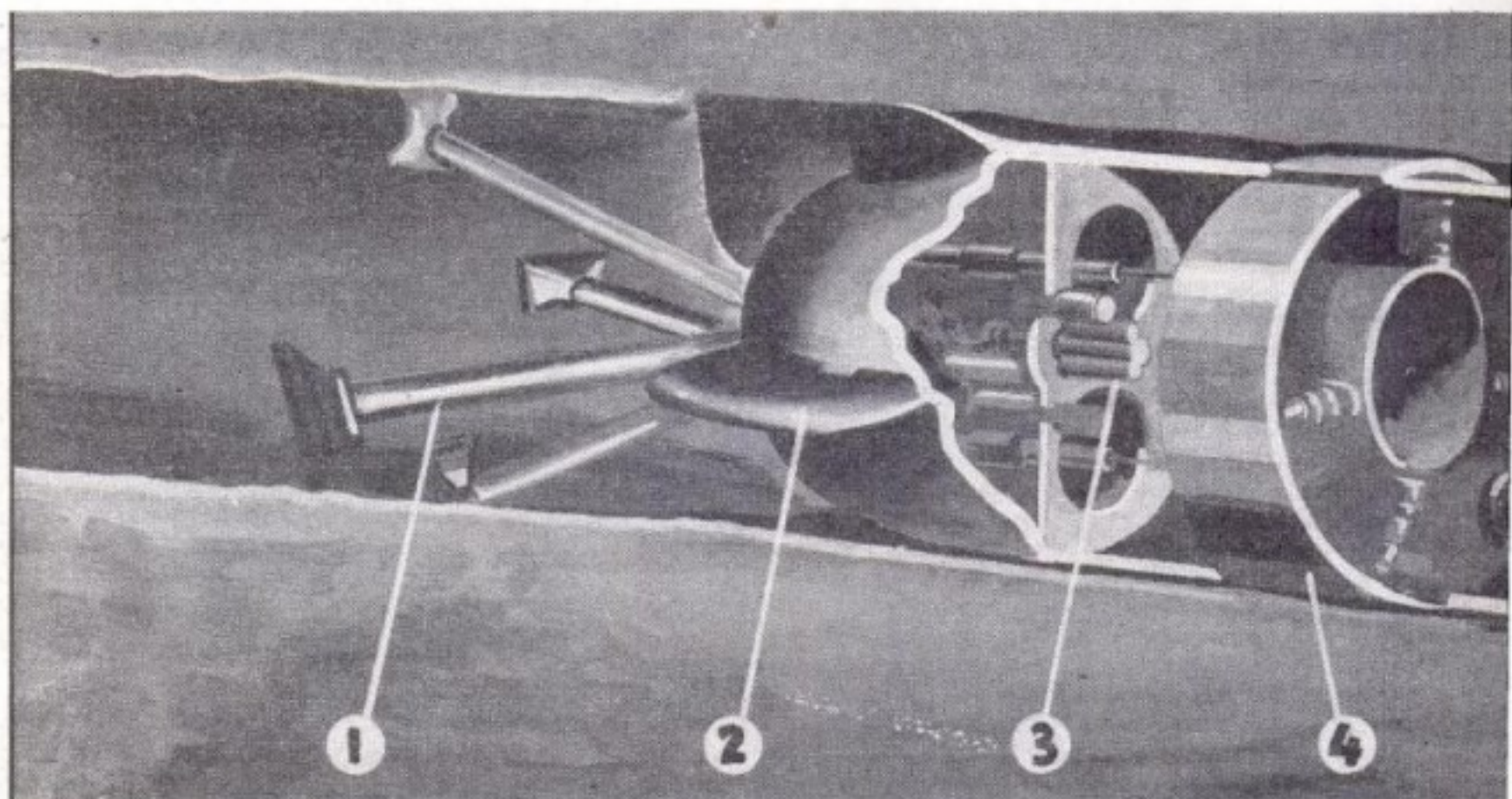
But even where this method is practicable, it is inconvenient to have great trenches dug in urban areas. It is because of these difficulties in making tunnels that a new method described in a Russian technical journal is highly

interesting. It involves the use of "mechanical moles" or "underground boats" capable of making tunnels at high speeds.

The basis of this work was the discovery, well known in Britain, that the faster you cut something, the less pressure you required to do so. For example, in cutting metal the pressure required at a speed of 1,500 feet per minute is only about half that required at 100 feet per minute. In other words, the faster the speed of a machine tool the less power is required to cut the metal. This is a general rule applicable to all metal-cutting operations.

The Russians claim that the same rule can be extended to soil drilling and cutting.

They carried out tests on the relationship between power and the speed of cutting with a soil-drilling machine fitted



The displaced earth falls away on the moles withers and is pressed against the tunnel walls by the movement of its shoulder muscles

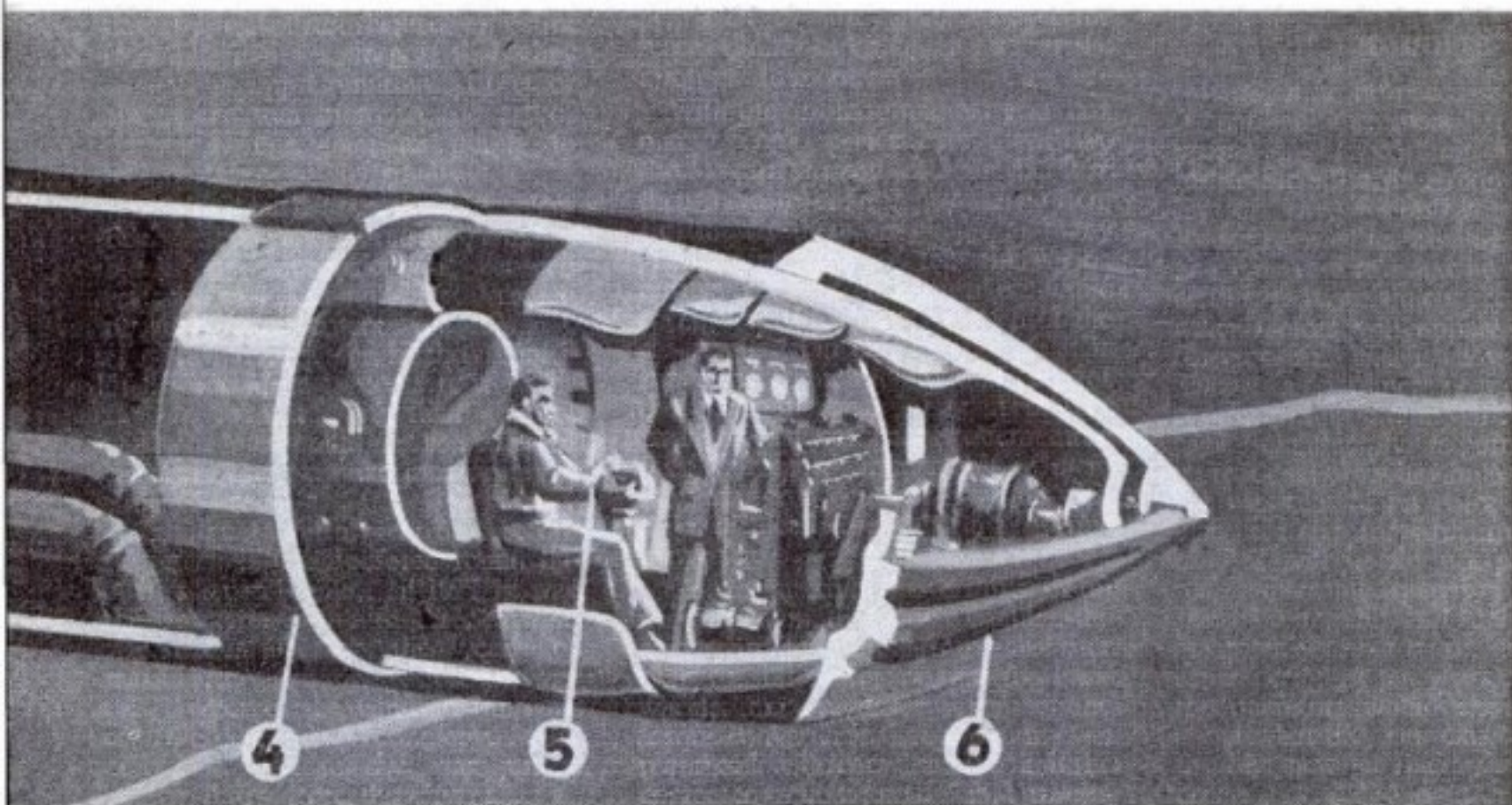


To dig, the mole works head and paws to the right and left

The burrowing animal moves forward by pushing with its hind legs

The mechanical mole (shown below in an artist's impression) is based very closely on the techniques of the earth-mole. The propellers (1) perform the same function as the earth-mole's hind legs, exerting their thrust against the side of the tunnel. Stabilisers (2) prevent the machine from turning over. The forward-movement motor is at

the rear (3). Perhaps the most remarkable derivation from the earth-mole are the expanders (4) which press earth into the sides of the tunnel, conforming to the creature's withers and shoulder muscles. The driver's compartment is shown (5). The digging is performed by the rotating boring head (6) which is edged with cutters.



RUSSIA'S MECHANICAL MOLES *continued*

with a screw drive. The action of such a drill bore a certain resemblance to the operations of a mole, and so Russian scientists made a special time-and-motion study of this burrowing animal's methods of work.

There were encouraging precedents for this research. The history of technology contains many examples of the development of machines based on the study of nature. The laws of aerodynamics were derived from studying the flights of birds. A study of fish contributed much to the development of the submarine. So it appeared logical to the Russians to study the mole in order to develop what they had so far called "underground boats."

The investigation of moles' technique was carried out in the Ural Mountains. Local hunters taught the Russian scientists how to catch moles. Then the lengths of the captured moles from tip to tail were measured. Next the animals were allowed to burrow, and the duration of their task was timed with a stop-watch from the moment they started digging to the moment that the end of their tails disappeared into the earth. In this way the speed of digging under various conditions was calculated. In clay, the mole burrowed at the rate of 234 feet per hour and, in black earth, 361 feet per hour. In some cases even higher speeds were attained.

The second part of the investigation was carried out in the laboratory. A box measuring 16 inches square by 8 feet long was used. The box was packed with a clay soil and arranged in front of an X-ray machine. A mole was placed at the front end of the box and it started to burrow its way through the soil in the box. By X-ray photography a record of the mole's progress was obtained, showing the movement of its muscles and skeleton.



When digging, the mole moves its head and paws to the right and left around the axis of boring. The earth which is displaced in this manner falls away on the mole's withers and is pressed against the walls of the tunnel by the movement of its strong shoulder muscles. The mole achieves its forward movement by pushing with its hind legs. The X-ray photograph of the skeleton of the mole in action showed the extraordinary relative size of the vertebrae of the neck, of the bones of the shoulder blades and of the humerus.

The most important part of the mole's work is to press the earth which it has scooped out into the walls of the tunnel. The "mole hills" which we find above ground are of negligible size compared with the amount of earth which has actually been displaced. If the mole carried to the surface all the earth which it has scooped out in a burrowing operation, a considerable hill would be formed. The Russians noticed that the hardness of the walls of the tunnel was much greater than that of the surrounding earth.

From the lessons learned with the mole, the Russians built a mechanical model, followed by a larger scale machine, consisting of a cutter, corresponding to the mole's head; a worm for ramming loosened earth into the walls of the tunnel, corresponding to the withers; and propellers, corresponding to the hind legs.

In the front part of the body of the machine is a powerful cutter made of hard alloy. Behind are the four propellers which push against the walls of the tunnel and move the machine forward at a speed of thirty feet per hour. The cutter rotates at a speed of 300 revolutions per minute. For use in hard soils the cutter can also be given hammer blows as it rotates.



The driver sits inside the machine and can steer it to either side, up or down by means of the four propellers, in the same way that a crawler-tractor driver controls his vehicle. The driver can also reverse the machine using all four propellers and reversing the motor. Around the machine are reinforcement rings which press any loose earth into the tunnel walls.

This machine was built in the Urals in 1946 and used on the Blagodat Mountain. It was the first "mechanical mole" in which men could travel underground.

Since 1946 there has been much development in these underground machines involving increases in speed and in the diameter of the tunnel which can be bored. Similar mechanical moles have been at work in the Donbass region since 1953.

The French have also designed a machine of this type built on the cross-screw principle, but the Russians claim that the French device requires more power to overcome friction. Other types of underground travelling machines have not been fully mechanised.

Underground boring machines find their main application in making tunnels for various types of urban service (gas mains, electric cables, etc). A substantial advantage of the mechanical mole is that it does not have to remove the earth which is loosened during the tunnel operations, but presses it into the tunnel walls and leaves a smooth surface behind it.

There are many other potential applications in agriculture and industry for a cheap and speedy tunnelling machine. Such machines will be used in the Urals for irrigation and water supply channels: they will enable drains to be laid swiftly beneath swamps and bogland.

Another application of great promise is the underground gasification of coal, which involves cutting tunnels vertically and horizontally through the coal seam. Russian engineers claim that the most difficult problems in the design of the machines have now been overcome, and that they will be built on an increasing scale in the future.



One thousand up

Being a skim through the past 20 years of science and technology as *New Scientist* recorded them

Ian Low

Dipping into the past 1000 issues of *New Scientist*, the thing that impresses me most is the faithfulness with which the magazine has reflected the intellectual—and emotional—climate of the western world. The past 20 years have been a bumpy road and many notions, not only scientific ones, have dropped off the back of the cart.

The contents of early issues are stamped with an authority, expected of scientists in the aftermath of their wartime successes, which comes across strongly. A vast procession of the great in every department of knowledge—Nobelists as well as a host of Royal Society Fellows—treads across the pages week after week, benign, patient, and never condescending.

The first issue was a canny mixture of the far out (oestrogens seem to prevent wrinkling) and the close at hand (the Suez oil crisis and nuclear power stations). There was also that fondly remembered article: Why colour TV is far off. Cassandra, the *Daily Mirror* columnist, commended the new production to his millions of readers. It cost a bob, incidentally.

The new journalistic exercise took a little getting used to, especially among those accustomed to the grey prose of learned journals. An early criticism of UNESCO (international institutions were still revered) drew this from a reader: "In a scientific publication one is accustomed to find informed writing, a balanced judgement and restraint. It would be a great pity if the editorial tone of *New Scientist* is going to resemble that of cheap journalism, which does so much harm to democratic life."

Some of the early topics have an eerie timelessness: "Railways in a rut", "We needn't eat sugar", "Why aren't there more women engineers?" And connoisseurs of technology can find in that first volume the first mention of "Russia's mechanical mole", which has surfaced at intervals over the years. Then, as now, letter writers were arguing about science and religion and Dr Irving Page (whom God preserve) of Cleveland was telling the AAAS: "Science has not given man happiness; that is fairly certain. It is a question in a few people's minds just how much it has even improved things."

The recently re-christened Peaceful Atom was enthusiastically chronicled. For instance, the Germans were planning a nuclear-powered locomotive which would be cheaper to run than one fuelled by coal. (Some predictions, though, did come true, such as trunk-dialling on the telephone system.) But concern over nuclear weapons was growing, too. Two articles discussed the possibility of Britain abandoning nuclear tests. "Yes", said Bertrand Russell; "no", said Angus Maude MP, using the argument that possession of the H-bomb would help Britain to choose neutrality in case of dispute between the US and Soviet Russia. (The leader of the week was talking about the effect on the aircraft industry of a projected US provision of IRBMs. No supersonic bomber might mean no SST.)

Although the hierarchical system was still largely intact,

there were stirrings, even in the 1950s, of a challenge that was still years away. Professor J. D. Bernal wrote an article urging scientists to find a more democratic method of organising labs that would get the best out of people. Certainly the financial stimulus was on the weak side. An advertisement in the same issue wanted a maths/statistics lecturer at the University of Manchester, for which the salary range was £650 to £1350.

Despite what one might suppose to be contrary evidence, the days of hard graft were thought to be numbered, and already some people were worrying over social problems that might emerge. Sir Charles Darwin FRS, one of the magazine's early contributors, concluded an article with these words: "All these considerations lead me to think that most of mankind are not fitted for a life of freely chosen leisure, because most would not know what to choose. Something equivalent to the compulsory games of the schoolboy would undoubtedly have to be instituted."

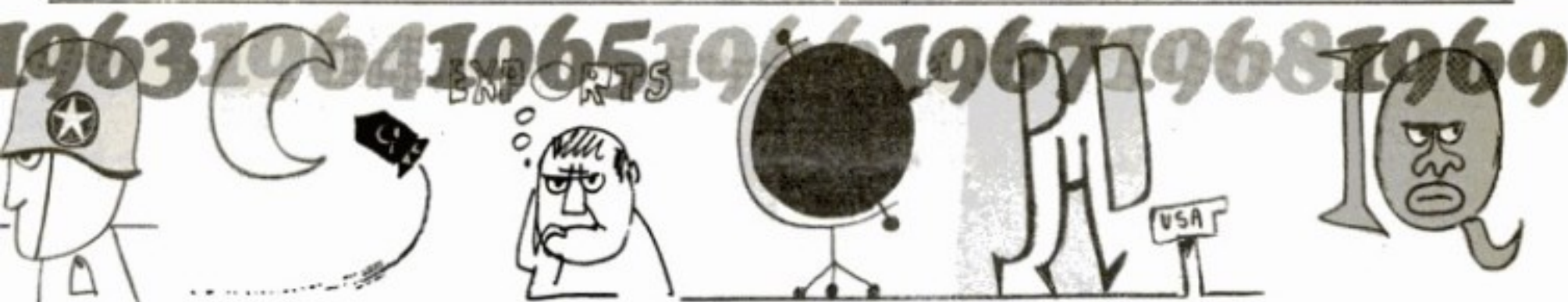
Environmental pollution in Britain was becoming a lively topic. Professor Richard Scorer pointed out that a ton of domestic coal did 140 times as much environmental damage as one ton of coal burned at a power station. There was intense interest in underground gasification and nuclear fusion, as well as in the long playing record and the International Geophysical Year.

So much for that first year. The anniversary issue carried a message of congratulation from the Duke of Edinburgh. Sir Charles Darwin was calling for more work on birth control to match the successes in death control. And a leader defended the use of animals in experiments; there had been a public row over the Russians sending a dog into space.

Forward looking, however, remained the order of the day. Here is Cockcroft on the next stages of Zeta: "the first milestone along what may be a longish road and we cannot see the end of it." Lovell was pleading for a British space programme. In 15 to 20 years, he believed, space vehicles might be taking people over the Earth in minutes. There were setbacks, though, such as the Windscale reactor accident (1958) which prompted the columnist Geminus to suggest that, in years to come, tourists, armed with geiger counters, might be taken round this "nuclear Pompeii".

Foreshadowing Skinner, Sir James Gray, in his 1959 BA address, wondered whether the biological sciences, especially those dealing with the behaviour of organisms and their relationship to their environment, yielded broad principles applicable to man "or must scientists be content to see the Law of the Jungle take its course except in so far as it can be restrained by humanitarian effort? . . . We must have the courage to believe and to teach that he can by means of his intellect control and direct his own evolution and destiny".

Technology at any rate was in fine fettle. There was a Commonwealth hypersonic aircraft project—nine times the speed of sound at 150 000ft for 12 000 miles non stop. A



Russian rocket hit the Moon and Sir Harrie Massey asked: "Men on the Moon in 10 years?"

Trends and Discoveries, forerunner of today's Monitor, was filling up its vast treasury of small insights such as the observation that rabbits swivel their ears towards visible, moving (even though soundless) objects. A Dr G. C. Cheesman's article was entitled: "The flavour of cheese". And Geminus cautioned: "I don't think it is yet practicable to expect that there will be much progress in the regeneration of the Sahara for some decades to come."

The year ended with a Christmas quiz by Bernal containing this question: What party was ruined with bleached candles and what did it lead to? (For the answer, see vol 6, p 1311.)

Still peering into the mists of the future a number of famous scientists were invited (1960) to have a stab at the next decade. Gabor scored at least a B++.

Industry, he wrote, was nearing the stage when its task would be not so much to provide people with goods as with satisfying jobs. There would be true thermal fusion by 1970, which year would also see the SST in use as well as transatlantic television by satellite. Zenon M. Bacq noted that "countries with a national health service must expect its costs greatly to increase by 1970". Zuckerman speculated on food production by non-conventional means and Sir William Slater went further—"New and unusual ways of raising production such as the feeding of synthetic oestrogens and antibiotics attract great attention, offering as they do an apparently easy way to profit." Abdus Salam, concerned with the decades' scientific discoveries, wondered whether there weren't some new fundamental particles around the corner such as dualons.

Pesticidal misgivings had barely surfaced. "Dieldrin," read one headline, "makes bigger cabbages." Bo Lundberg, however, was already chipping away at the SST concept. Apart from the sonic boom's effects on the environment, there were cosmic ray effects on the passengers to be considered. The argument then ran that we had to keep ahead of the Russians but Lundberg urged instead a "race for commonsense"—to ensure the highest level of safety and low fares using high-speed but subsonic aviation.

Early the following year came a US Supreme Court ruling ordering compensation for a property owner forced to move house because of jet noise. A NS leader commented: "There is no expectation that this method [silencing] can bring the noise of the big liners to a level that would meet public objections. The future of commercial air transport (including the new developments such as vertical take-off and supersonic airliners) is in the balance."

Salaries were going up. A senior lecturer in mechanical engineering at Bradford Institute of Technology was being offered between £1550 and £1750.

Blackett wrote an article for us urging British universities to second staff to developing countries without waiting for government initiative. By the end of the year, however, the battle cry had become: university science in danger. Lovell, Krebs, and Mott contributed their views. According to Lovell, the country's total research budget had actually decreased at least by a factor of four during the past 25 years, yet the university budget had gone up

by only three times. Krebs mourned that Oxford would have to wait 15 years for "buildings we need now."

By the following year (1962) the mood had changed and Geminus was rhapsodising: "As with Morris dancers and circuses so with university professors, society cannot have too many. Even when they serve no useful purpose I applaud their creation."

The highlight of 1963 was, of course, the 1984 series of articles which attracted wide attention and were published in book form by Penguin. Abdus Salam, writing of the Third World in 1984, commented: "I am resigned to Orwell's grim picture." Stanley Kubrick's Dr Strangelove film reached the screens but *New Scientist*, while seeing nothing wrong with the caricatured general, found the mad scientist too much to swallow. Was the producer's purpose to focus the hatred of the audience on science in general through this "grotesque and unnecessary appendage to the plot"?

The 10th anniversary rolled around and the Duke sent his congratulations. Nigel Calder (the second of four editors till now) looked over his shoulder at the early days of struggle. The surge of public interest occasioned by the first Sputnik had put new life into the magazine's circulation (and its finances) when the future had looked distinctly bleak.

By 1967 there was the real or imagined phenomenon of the brain drain to the United States, and the better documented swing away from science (towards sociology) among under-graduates. Both topics occupied much leader space. There was also a spate of articles on the search for the intelligent machine, while the long love affair with the Hovercraft continued unabated. An effective campaign was mounted, in which the present editor, Bernard Dixon, played the chief part in highlighting the public health risks in using antibiotics to improve meat yields.

The scientists, reacting to the severe criticisms of science (often better directed at technology) which had spread from the US to most European countries, were now engaging in debates on morality. NS ran a leader in 1968 calling for a code of conduct among scientists, commenting hopefully that "it should at least be possible to formulate broad principles of behaviour."

Despite the doubts, however, technology was still capable of extraordinary flights such as Pilkington's Sea City—30 000 inhabitants living on the edge of the Hewett gas field but only 25 minutes by Hovercraft from the Suffolk coast. Much of the city, of course, made of glass. There was also something called an inverted hovertrain. (Whatever became of that?)

The following year, the great IQ row broke out. What looked like hard evidence that US blacks were intellectually inferior to US whites was provided by a paper in the *Harvard Educational Review* by Professor A. R. Jensen. NS's issue of 1 May contained articles by Sir Cyril Burt, Hans Eysenck and Dr Sidney Irvine. Coming as it did at a time of social upheaval, the argument over Jensen's impeccably academic findings provoked outbursts of emotion, both in the US and in Britain, and eventually a body of eminent scientists had to issue a manifesto insisting on fair play for scientific ideas.

1969 was also notable for the Sternglass controversy. Had



nuclear testing in Nevada substantially retarded improvement in infant mortality, as Dr Sternglass (of Pittsburgh University) claimed? Or had he got his data wrong, as Dr Leonard Sagan suggested in *NS*? The controversy may still continue, toe-to-toe, but by August *NS* was airing Tony Benn on the subject of privacy and data banks, a subject of much public alarm. Benn was unworried. "It may be," he wrote, "that it is only in the world of total information wholly computerised that we shall feel safe enough to remove the fig leaves, which Adam and Eve found it necessary to don when they first tasted the fruit of the tree of knowledge and forgot that they were people with nothing to hide . . . the hypocrisy in society may give way to compassion."

Room was also found for old topics, as witness the remarkable interest created by Professor Donald Mackay's article (1970) on the bankruptcy of determinism. For weeks on end, the correspondence columns had the air of an earlier age.

But we were soon back on the social responsibility trail again. Sir Ernst Chain provided a vigorous counter argument to those whose queasiness extended to work for governments, particularly in the military field. "The first responsibility of a scientist," he insisted, "is to the nation of which he is a member."

The misgivings, however, were not easily dispelled. Theodore Roszak, whose *The Making of a Counter Culture* had caused a considerable stir in the scientific community, now brought out (1971) *Where the Wasteland Ends* from which, in a *NS* excerpt, these words are taken: "Our nearly single-minded commitment to the objective mode of consciousness has led us not to the promised New Jerusalem but to the technocratic trap." The Faradays and the Galileos—the great lone wolves—were gone. "Science is cumulative . . . It exhausts the intellectual terrain as it races forward." A scientist interviewed later scorned Roszak's argument that objectivity dehumanised the scientist. "My fascination for the way a seed grows and develops is vastly greater not less now I know something about it."

Technologists were rubbing their hands over the killing to be made out of video cassettes. According to one article, 1971 was to be the first year of the new industry with a £100 million a year market. By the 1980s there would be from two million to five million players in Britain. But in August 1972 *Technology Review* was saying: "Still no boom in cassette TV."

In that month, too, Bernard Dixon was writing: "At the moment scientists are passing through a corporate menopause, stricken by anxiety as to how they will emerge from it. Some will surface unscathed and even rejuvenated from the process. Others won't."

Long-running topics (in this case global overpopulation) sometimes need a healthy jolt. Professor John Postgate's article in April 1973 provided one. He suggested that what might be needed was a pill to guarantee that a couple's first child would be male. It would be only through the gratification of this traditional ambition that stabilisation could be achieved. He conceded that there would be fearful social consequences "but to do nothing would be worse." Readers' letters dwelt mostly on the horrors.

One of the fringe phenomena of the 1970s has been the increasing interest in parapsychology. Although the folk mythology tended to concentrate on the feats of Uri Geller (whom *New Scientist* challenged in vain), there were topics such as Kirlian photography ("Are psychoenergetic pictures possible?") which some scientists were prepared to take seriously. The Hovercraft, that technological Mary Céléste, looked like finding port at last. Though there were still only a few hundred of the vehicles in the world, Joseph Hanlon wrote: "In the past few years attention has turned from high speed over water to carrying loads over difficult terrain."

The shock to the economic system produced by the sudden increase in oil prices seemed to encourage neopuritanism. Recycling of wastes of all kinds, conservation of natural resources, plus a rampant enthusiasm for harnessing new energy sources were much written about. Colin Tudge was campaigning against the processed food industry. His slogan: "We must relearn how to cook."

Stemming presumably from the rapprochement between China and the US, there was a flurry of curiosity among medical scientists about acupuncture. Professor Pat Wall of University College London made an on-the-spot study, as reported in a *New Scientist* article showing that the treatment did not work very well on many people.

Harvest failures in several countries as well as the knock-on effect of oil prices on the chemical fertilisers industry gave new urgency to international famine programmes. *New Scientist* devoted most of one issue (7 November, 1974) to various aspects of the problem, in which Jon Tinker analysed the complexities of a situation for which the Green Revolution was no match.

One of the most outstanding contributions of 1975 (or, for that matter any other year of the magazine's existence) was the article by Dr James Lovelock and Dr Sydney Epton, entitled 'The quest for Gaia'. It put forward the awesome hypothesis that the Earth's living matter, air oceans and land surface might form part of a giant system which could be seen as a single organism (Gaia). Man's activities might be crucial to the system. The authors wondered whether there were any signs that we might have triggered something off already? "There is at least one such possibility—the present puzzling climate."

One of the humbler elements of Gaia, the field mouse, produced a delightful cover drawing to illustrate the suggestion by Professor Robert Berry that the Hebridean variety had come across in the Viking longships.

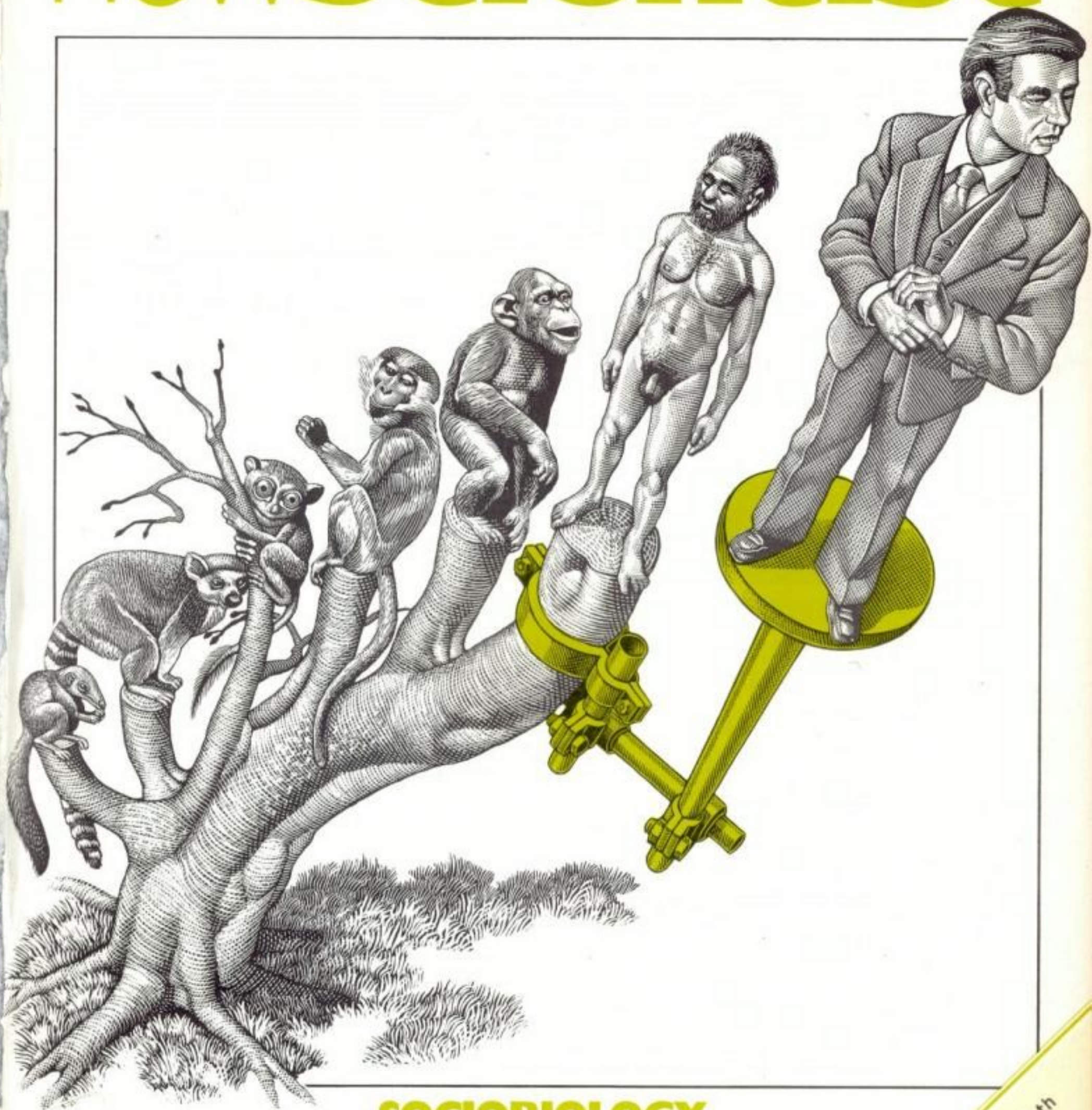
Reality was becoming sterner, at least economically. In March we mounted a one-day conference to discuss stratagems for making Britain self-sufficient.

A questionnaire on science and scientists revealed that the 20 most frequently quoted names of scientists given by respondents were led by Archimedes, "Prof Branstawm", and Bronowski. Newton, at No. 13, was only three places ahead of Magnus Pyke.

In the upper atmosphere of mathematics, considerable turbulence was created by René Thom's seven elementary catastrophes and Dr Ian Stewart made a heroic effort to give readers an understanding of their mechanism.

These, then, are some of the things that made up the first 1000 issues. New readers begin here.

newScientist



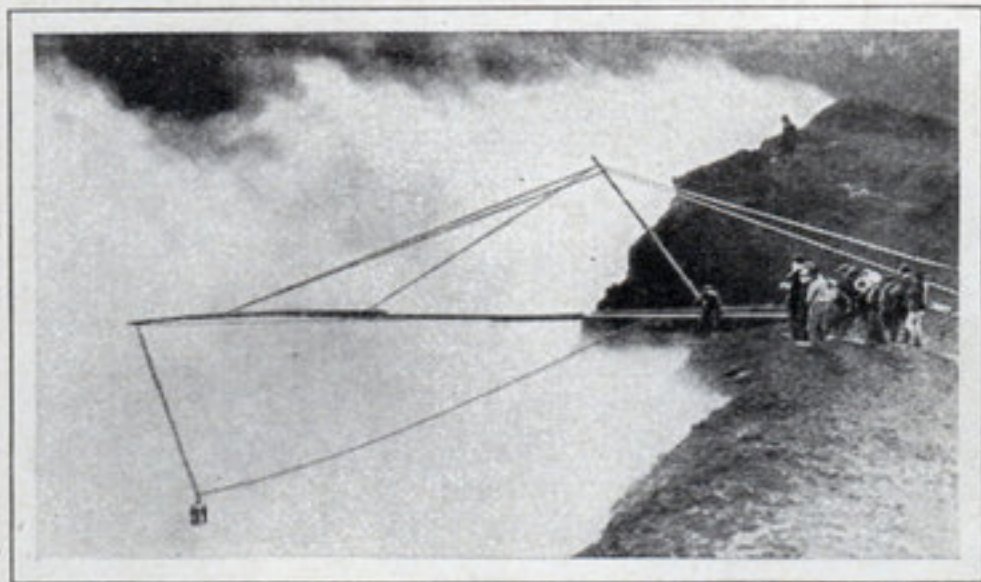
SOCIOBIOLOGY

Analysis of human nature-or political device?

1000th
issue

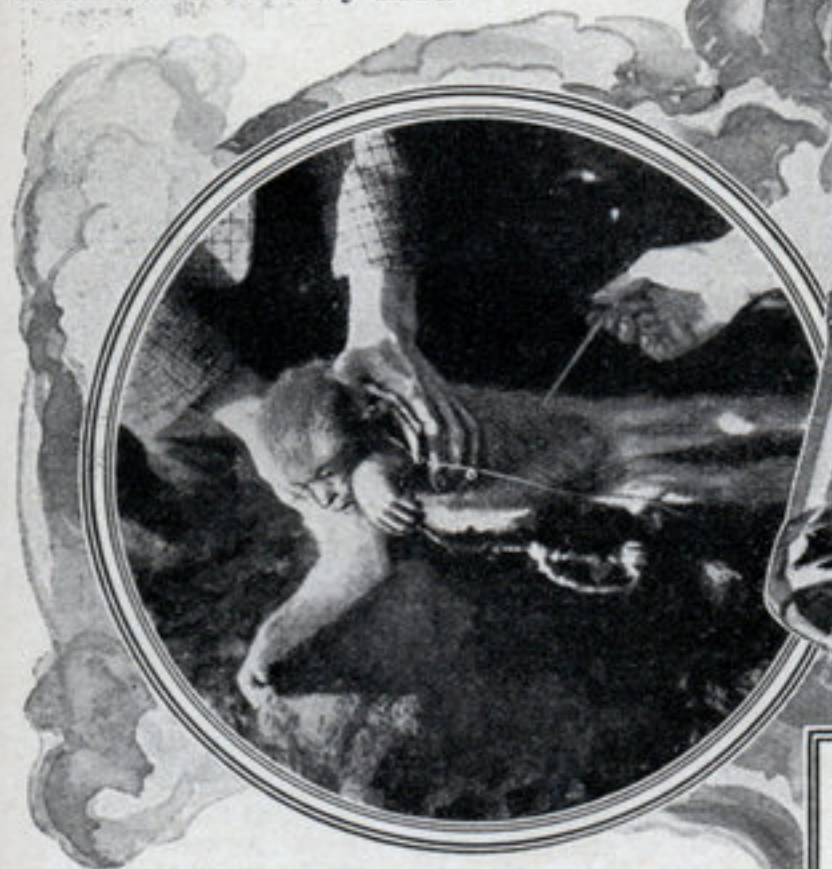
Braving the INFERNO of a VOLCANO

Amazing plan to descend flaming crater hanging in cage from a derrick!



Above photo shows scientists lowering a crate of guinea pigs into volcano near Tokio to test deadliness of fumes.

LOWERED to a depth of a thousand feet in the boiling, fume-filled crater of Mt. Mihara, near Tokio, Japan, scientists who are now carrying out an amazing program of volcanic investigations will hang in a tiny metal cage over a bubbling flood of molten lava, suspended only by a thin steel cable. Details of the device are given in the accompanying drawing. A live monkey, guinea pigs and rabbits were used in testing the toxicity of the volcano's gases. Mt. Mikara is a favorite spot for suicides, 50 people having leaped to their death since January first.



In circle—this monkey was lowered into crater to test effect of fumes on man. Although overcome when removed, as shown in picture, he speedily recovered and scientists decided that with proper protection men could descend into the crater with impunity.

In a cage of metal lined with asbestos, with quartz windows which resist heat, scientists will make observations inside the crater of Mt. Mihara, near Tokio, Japan. A derrick will be used to raise and lower the cage. A supply of oxygen is carried in containers, enabling the men in the cage to stay down for long periods. Communication with the derrick operator is maintained by telephone.

"Brain Wave" Airplanes



The Cierva autogiro or "windmill" plane shown above was regarded as a typical freak or "brain wave" design in some quarters when it was first introduced, but it has proved to be a practical flyer which can land in a remarkably small space. The six-story plane pictured at the right is a less successful design. It is the invention of W. F. Gerhardt and was tested at Wright Field, Dayton, Ohio.

by JAY EARLE MILLER

Will the airplane of tomorrow develop out of present day "brain wave" designs, so-called because of their freakish departure from generally accepted principles? It is quite possible, as Mr. Miller points out, that the airplane of the future will be entirely different from conventional types we are accustomed to.

WHAT will the airplane of the future look like?

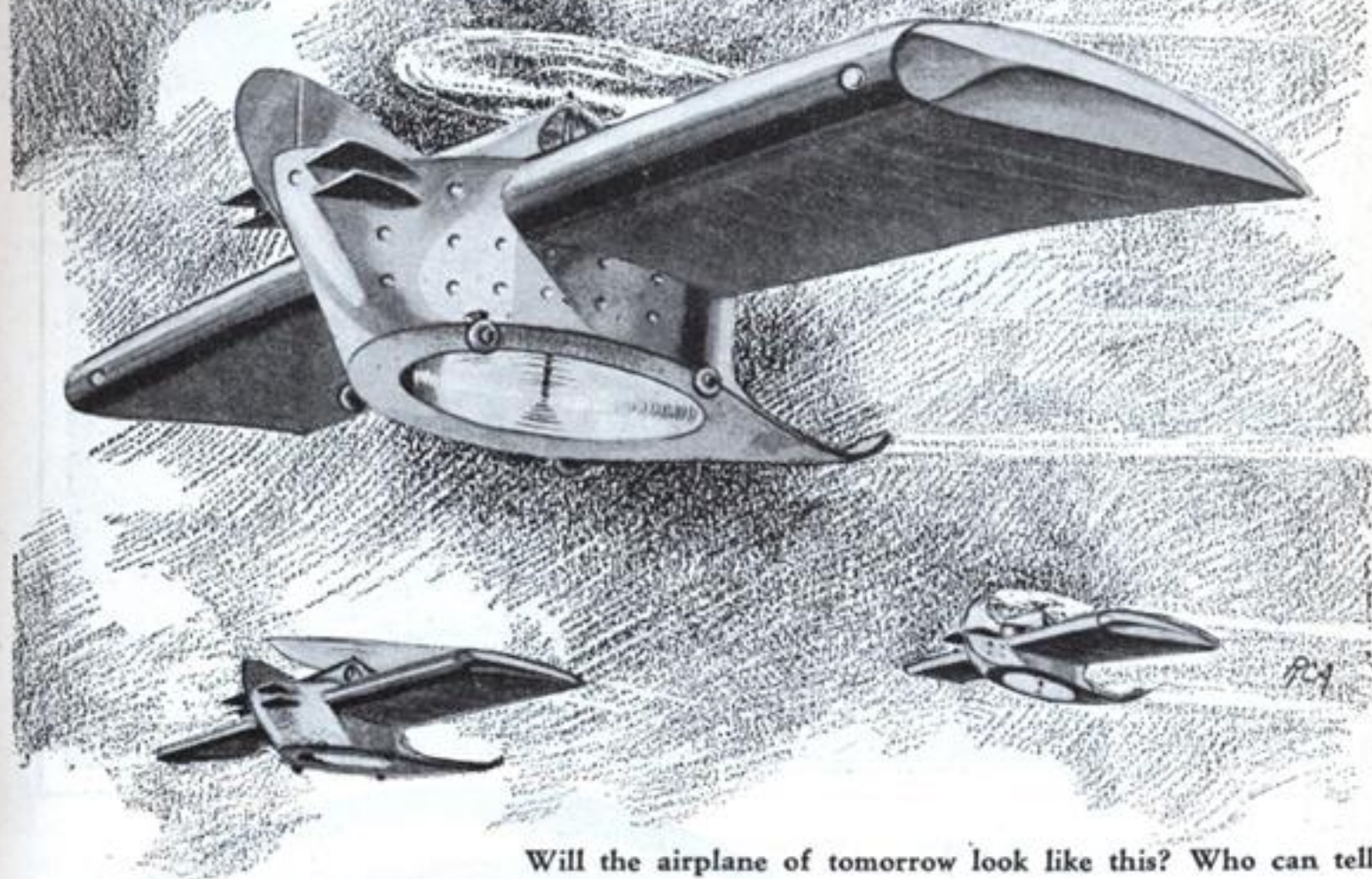
Will heavier-than-air craft continue to develop along present lines, with refinement of detail, or will something radically different be produced and prove better than existing planes?

When the De la Cierva auto-giro made its first appearance in England an aviation authority condemned it on the grounds that it "didn't look like an airplane" and there-

fore couldn't be much good.

Another authority countered by asking what an airplane should look like. There is no reason for believing, he pointed out, that because airplanes have developed along certain lines that those lines are the best, safest or most efficient. With the exception of the few planes equipped with the new Packard Diesel engine, the airplane power plant is a direct descendant of the Wright brothers' original four-cylinder gasoline

WILL THEY FLY?



Will the airplane of tomorrow look like this? Who can tell?

engine. The propeller has changed but little from the first one they whittled out, though there is reason to believe that a radically different type of propeller might be more efficient and is bound to come. And the plane itself is still based on the earliest models.

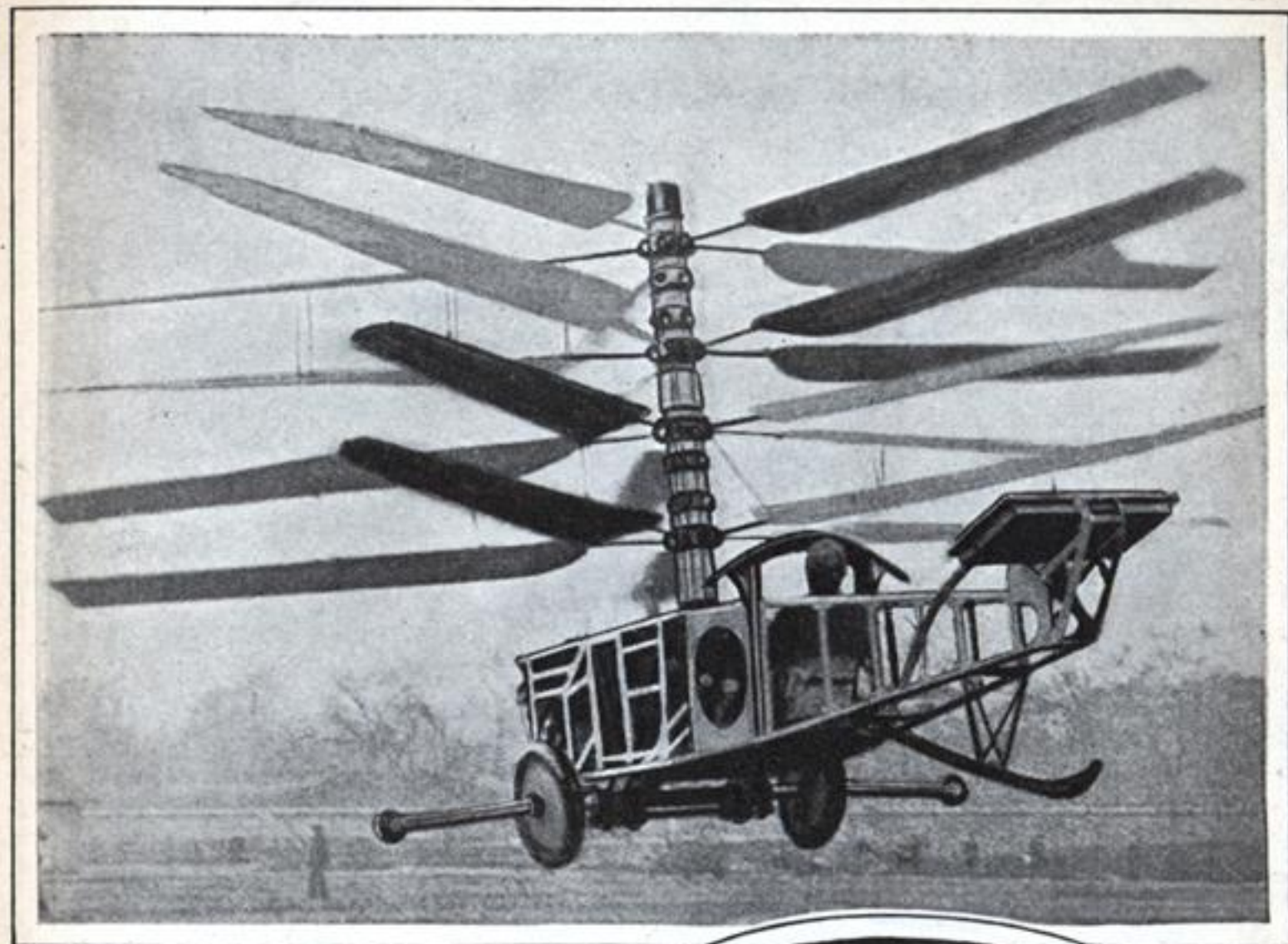
Helicopters, such as the one recently built in the Curtiss plant on Long Island, ornithopters and orthopters all represent attempts to get away from the standardized design and produce something new and better. A helicopter, as you probably know, is a machine designed to rise and descend vertically and hover over any given spot. An ornithopter is a flapping wing machine supposed to be a mechanical copy of a bird's wing, and an orthopter is a flapping wing machine which the inventor believes is an improvement on a bird. A famous aviation editor once described an ornithopter as the inventor's idea of how a bird's wing worked, and an orthopter as the designer's idea of how a bird's wing should work if the Creator had known anything about aerodynamics.

The Curtiss-Bleecker helicopter is unique in that it has no propeller for forward motion, being equipped with only revolving wings for lifting. The theory is that the ship will move forward by tilting its center of gravity to start it falling, while it will actually fall forward instead of down, because of the lifting effect of the revolving wings.

You can demonstrate the theory easily by holding a board or piece of cardboard in one hand, with the free end inclined downward, and start a pencil rolling down it. The pencil loses altitude as it rolls, but if at the same time you lift your hand and raise the board you can make the pencil, while falling, maintain its altitude, or even increase it.

A Chicago inventor has gone even farther than Bleecker, for he is building a heavier-than-air machine which has no wings. It is a cigar-shaped metal body, approximately thirty feet long, equipped with small retractible, feathering propellers on either side. The blades revolve in drums partly

Helicopter or Vertical Rising Plane Has Long Been Dream of Inventors



This helicopter designed by M. Pescara is shown in the air during a brief flight made from a Paris flying field. The tiers of vanes revolve in opposite directions.

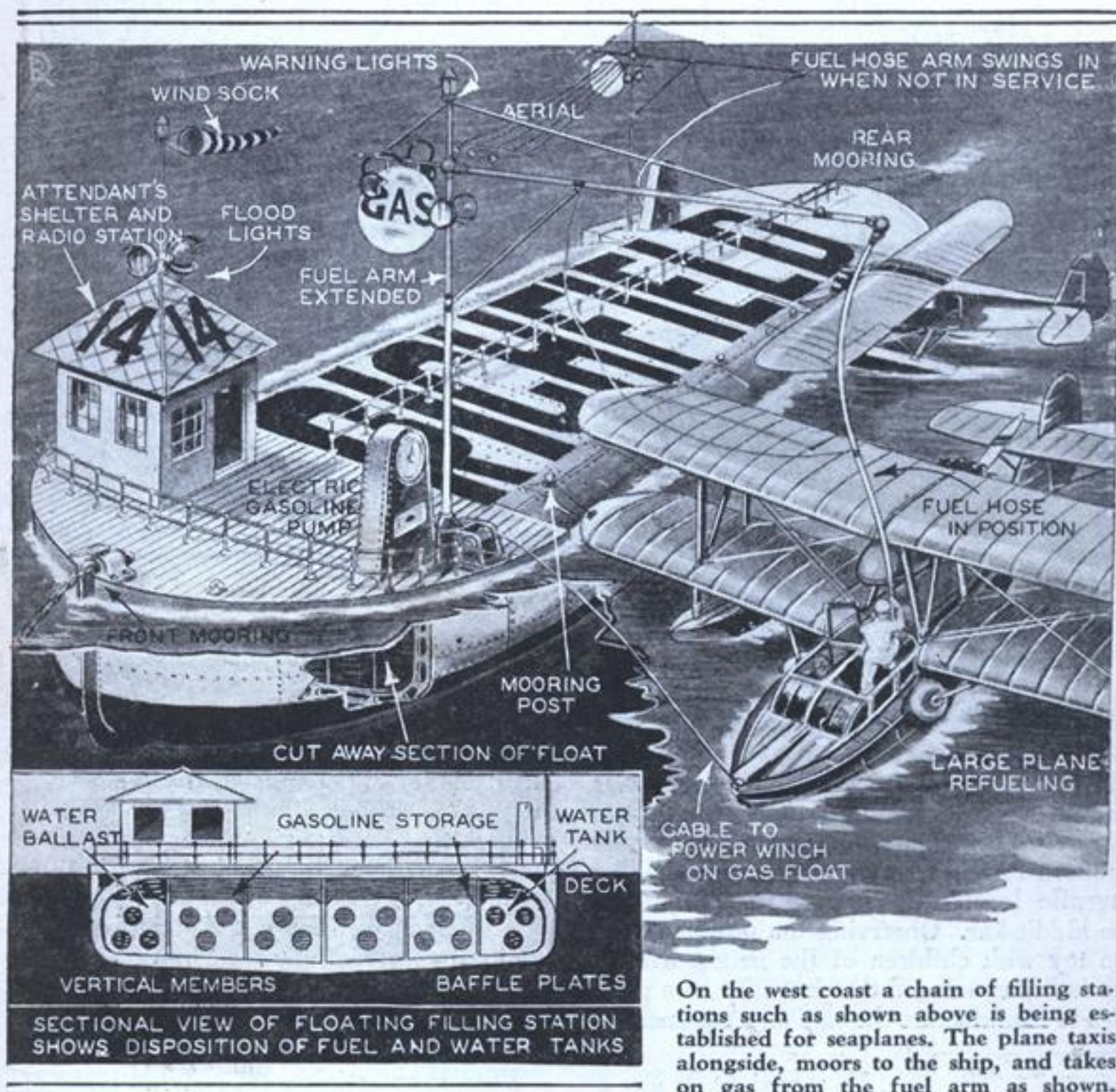
within the body, and as each blade emerges through the side it is turned by a cam arrangement, sweeps downward, feathers and withdraws again into the body. There are eight blades on either side, and the surface area is extremely small.

His theory is, and wind tunnel tests have shown some reason for believing it might work, that the small, specially shaped, high speed blades will sweep the air downward from above the ship, creating a partial vacuum, and the normal air pressure beneath the ship, of 15 pounds per square inch at sea level pressure, plus the increased pressure of the displaced air, will force the ship upward into this vacuum. Altitude attained, the center of grav-



This parasol plane, so-called from its umbrella-like top, represents the culmination of ten years' work on the part of its inventor, R. H. Van Wie, of San Francisco. It is about as broad a departure from conventional airplane design as can be imagined. Note the twin propellers under the parasol.

Floating Fuel Station for SEAPLANES



IN THE future, when airplane travel comes to be as commonplace as automobile travel, we may expect to see floating filling stations, such as shown in the drawing above, dotting the airplane travel lanes of the Atlantic and Pacific oceans. This is by no means a fantastic project of dreamers, for already just such floating service stations are to be seen scattered along the Pacific coast; and a west coast oil company, looking to the future, has announced its intentions of establishing a chain of 99 such stations for the accommodation of planes journeying up and down the seaboard.

These floating service stations are marked by neon lighted towers and are equipped to service a plane in any way necessary, their

chief function, however, being refueling. A wireless transmitter and receiver keeps the station in constant communication with land, so that weather information and emergency orders can be provided for the pilots. When a pilot wants to take on fuel he brings his ship up alongside the barge, fastens his mooring lines to the mooring post, and swings the hose, which is attached to the projecting fuel arm, into position and signals to the attendant to begin pumping.

The barge is moored in place by means of anchors. All fuel tanks are below decks, with no projection above save for the office at the stern. The fueling pumps are sunk in pits to safeguard the wings of planes moored alongside.

Highway Will Span Two Continents



For the first time in history the Arctic circle will be joined with the equator by an improved road. This map shows the projected International Pacific Highway and the Atlantic Highway being planned by Argentine and Brazil.

FROM the land of the midnight sun down the Pacific slope of two continents a 16,000-mile highway will stretch, linking Alaska with the Argentine.

Already the road has been surveyed on the ground and from the air from Central America to Fairbanks, Alaska. At the moment a party of five men are fighting Central American jungles, chopping their way down canyons and across mountains to Panama, mapping what will become the central portions of the long highway.

From Alaska to the Argentine government officials and highway enthusiasts have banded together to assure the success of the giant undertaking—to build a one billion dollar highway. Today nearly one-fourth of the long road already is improved, at costs ranging from \$500 to \$85,000 a mile. In the three Pacific coast states—Washington, Oregon and California—the International Pacific Highway, as it will be known, already totals 1,560 miles, all paved. Down in Mexico, the govern-

ors of the Mexican states have formed a Mexican Highway association to help each other in stretching the narrow ribbon of roadway across the nation. Long before the

highway pushes across Central America it will traverse a land of an unconquered people, the much-feared Yaqui Indians. When

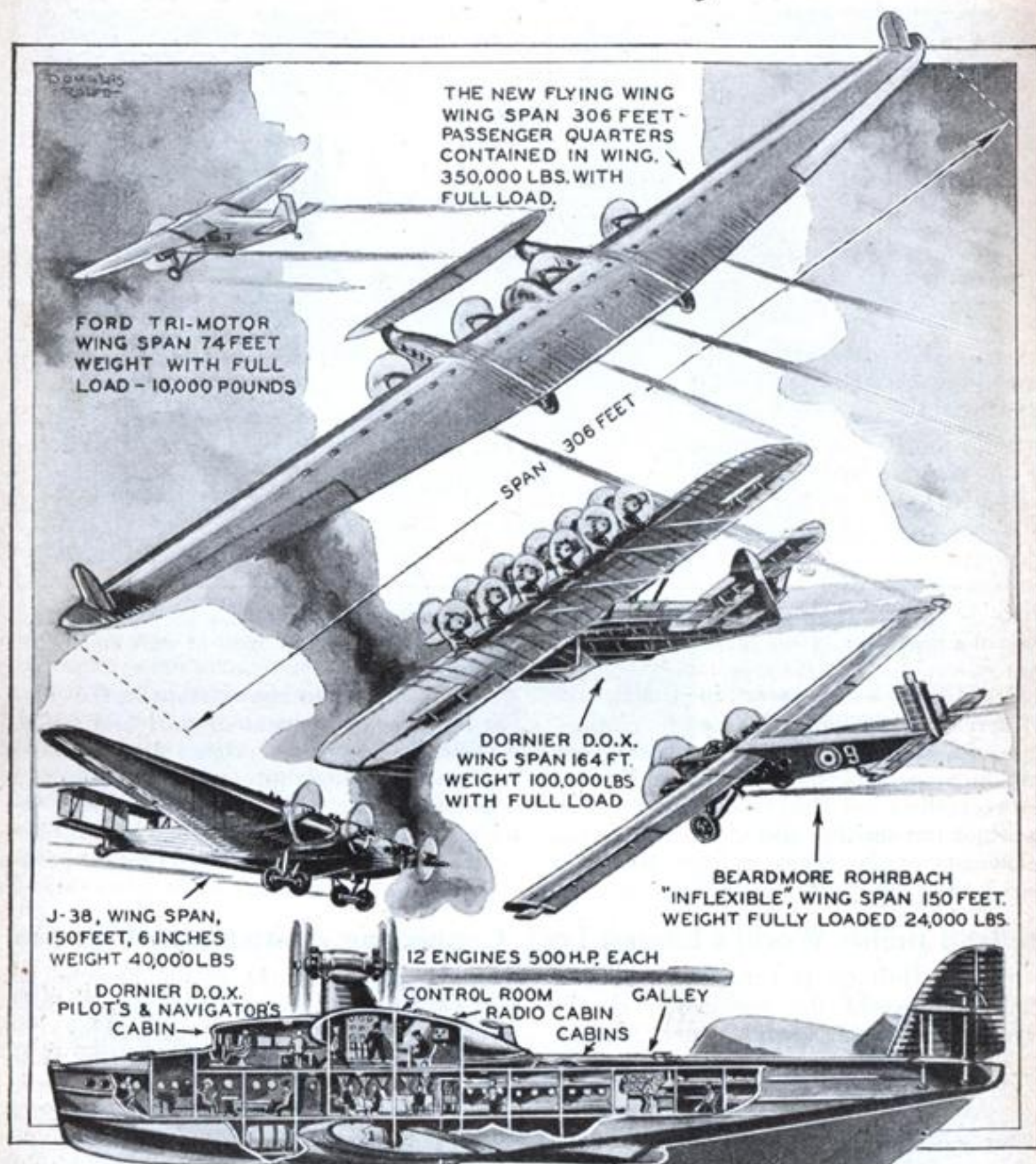
the party of trail-blazers, sent out several weeks ago by the Automobile Club of Southern California, sponsors of the inter-

continental project, traversed Sonora, an armed military escort crossed the Yaqui country with them.

On this narrow ribbon of hard surface you will be able to traverse, figuratively without leaving your car, the most productive regions of the world, see and talk with the most progressive peoples during a journey longer than half-way around the world.

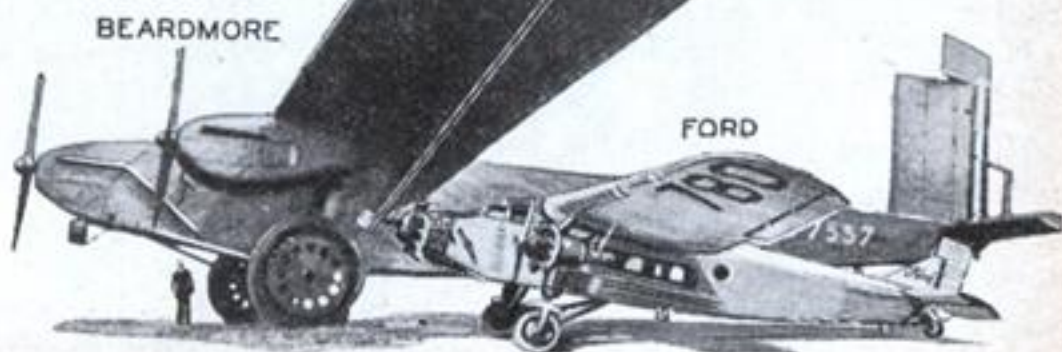
Each country will build its own segment of the long road. Some will put down concrete, others gravel surfaces—but throughout the long route you will be able to drive your car on a roadway that will have the stamp of approval of a dozen governments.

LEVIATHANS of the Air



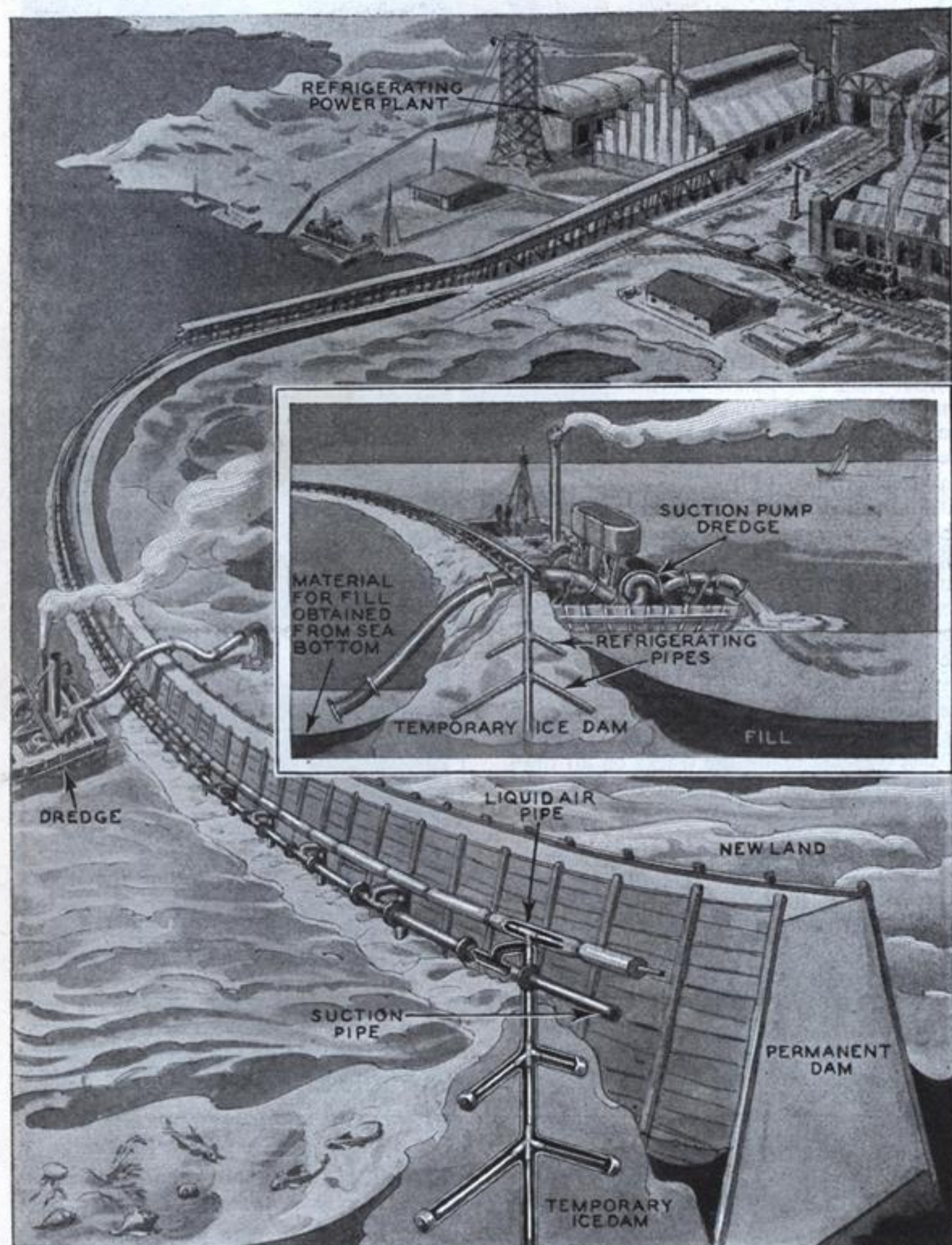
A comparison of the world's largest planes, showing how Europe is forging ahead in the design of air liners.

GERMANY, forbidden to construct military planes, has turned her attention to commercial craft. The world had no sooner recovered its breath from viewing the Dornier "DO. X" than Junkers announced a plane which would carry 175 tons.



Above is shown how America's largest ship, the Ford Tri-motor, compares with Britain's giant Beardmore Rohrbach "Inflexible."

LIQUID AIR to RECLAIM



In carrying out the proposed project of the German engineers to convert North sea area into habitable land area, with liquid air, a pipe line will be erected inclosing the portion of the sea as illustrated above. Salt water coming into contact with the pipes, which have been reduced to a temperature of 180 degrees below zero by the liquid air, will freeze and form a dam of solid ice. A dredge will then fill in the enclosed area with earth, drawn from the sea bottom with a huge suction pump.

LAND from NORTH SEA



Farms and villages will spring up on the land reclaimed from the North sea by means of the ice dam. Eventually the imprisoned water will be evaporated, leaving the bare sea bottom, which will be filled in and protected from the ocean by means of strong, permanent, concrete dikes. A system of canals similar to those of Holland will serve to keep the land drained, as illustrated in above drawing. The old coast line is shown in the background.



The above map shows the portion of the North sea which engineers propose to reclaim by the construction of the ice wall and concrete dam.

ONE of the most astounding engineering feats of recent years—that of building a wall of solid ice with liquid air around a large portion of the North Sea—is now under consideration by German engineers. Adding thousands of acres to the continent of Europe, the ice dam will serve as a breakwater to enable the engineers to construct a permanent inner dike of concrete, and then proceed to fill the inclosed space with earth sucked up by a dredge from the bottom of the sea outside the ice wall, as illustrated in the accompanying drawings.

Engineers will set about building the ice dam by erecting a pipe line out into the sea to carry liquid air, which will reduce the temperature of the pipes to approximately 180 degrees below zero. The sea water coming in contact with these pipes will congeal into

ice, and the waves will then tend to form a solid ice wall to serve as a breakwater for the inclosed area.

This much accomplished, engineers will then build a permanent concrete dike inside the ice wall, and by means of a suction dredge fill in the reclaimed area with earth sucked up from the bottom of the sea outside the wall.

This project, if proven feasible in preliminary experiments, will first be carried out in the North sea, shown on the map above, where for centuries the Germans have been trying to win land from the ocean. Liquid air will be supplied by refrigerating plants on the shore, and the pipe line will extend out beyond Helgoland and back to the mouth of the Weser river.

The Truth About Tidal



Havoc worked by tidal wave which struck Lisbon, Portugal, in 1755, taking 50,000 lives, is shown in this old engraving. The sea first receded then returned in a mountain of water over 50 ft. high which tumbled over hundreds of buildings.

by CALVIN FRAZER

ANY kind of an upheaval of the ocean's surface has generally been called, particularly by newspaper writers, a tidal wave, but according to the strict definitions of science this designation has been a greivous error. The error, unfortunately, has crept into the working vocabularies of scientists themselves, and now tidal wave has come to denote any kind of oceanic disturbance in which the waters of the sea rise up in their might and work havoc on ships at sea and inhabitants of the littoral.

Moon Causes True Tidal Waves

The true tidal wave is raised by the moon twice daily and does no harm to anybody. The gravitational attraction of the moon, some quarter of a billion miles away in space, exercises enough pull on the earth to raise a hump of water as high as 40 feet in places—the Bay of Fundy, as one case in point. On the other side of the earth a tide of equal height is also raised, while in between the water sinks to a level known as ebb tide.

The most striking effect of this true tide is noticeable at the mouths of rivers, where the outflowing current encounters an unusually high rise of tide. At low tide the river current runs into the sea in the usual manner, but when the waters of the ocean rise to the point where they are above the

WATER RUSHES IN
TO FILL HOLE

QUAKE CAUSES OCEAN
FLOOR TO SUBSIDE

MOMENTUM OF INFLOWING
WATER CAUSES MOUNTAINOUS
WAVE TO RISE

MOUNTAIN OF WATER
SUBSIDES, SENDING
OUT HUGE TIDAL WAVES

How earthquakes generate tidal waves. Mountain of water over pit on ocean floor subsides, sending out huge waves to work havoc on coastal villages.



Violent storms in the Bering sea beat up huge waves which carried these massive slabs of ice seven miles inland.

WAVES

Paradoxical as it may sound, tidal waves have caused some of the most terrible disasters in history, yet they occur twice daily without serious results. Here is an explanation of these oceanic upheavals.



Tropical hurricanes sweeping Gulf Coast were responsible for this disaster. Here is seen the "Ferraria," which was once the famous "Cutty Sark," smashed against docks at Pensacola, Florida. Radio storm warnings help guard against such calamities.

level of the river a strange sight is to be seen. A tumbling cataract of water creeps slowly upstream in a manner unaccountable to a spectator unfamiliar with the operations of tides. This cataract is called a bore, and it is caused by the high level water from the ocean flowing over the river waters moving outward, as illustrated in an accompanying photo. The cataract is three feet high and moving as fast as a man can run.

Origin of Destructive Tidal Waves

The tidal waves which inflict heavy losses of life and property on maritime regions generally have their origin in two sources. Tropical hurricanes, famous for their destructive fury, drive up huge storm tides that frequently descend upon a town or village along the seacoast and wipe out hundreds of thousands of dollars worth of property, and drown unwary hundreds of people at one fell stroke.

The terrific winds, rising at times to a velocity of a hundred miles an hour, beat up waves that attain heights of fifty and sixty feet. When these moving mountains of water strike a low-lying coastal village there is little that can be done by way of protection. As a rule these huge waves are followed by a series of smaller waves which tear up what is left of the devastated areas.

Now at the center of a hurricane, which moves forward with a circular motion, there is a low pressure area in which a

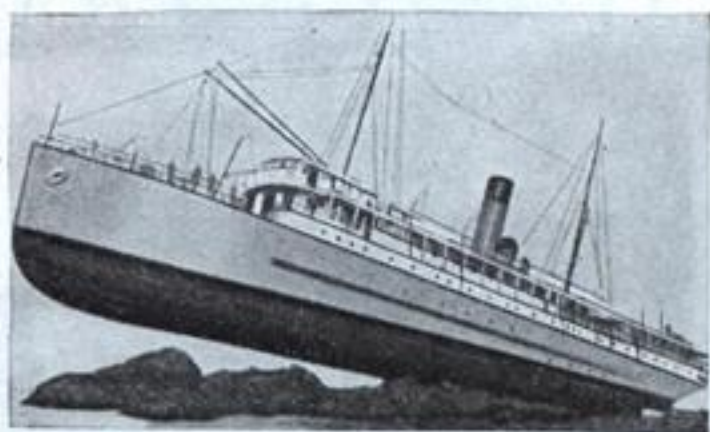
mound of water rises. When this low pressure area passes on with the hurricane, the mound of water subsides, and in doing so sends up a series of concentric tidal waves that sweep outward on missions of destruction.

Sometimes these tidal waves travel far



Powerful winds of tropical hurricanes cause many of the destructive tidal waves which strike and inflict heavy damage on maritime towns. Mound of water rises in low pressure area in center which subsides when storm passes, raising tidal waves as an after effect.

High Water of Sea Tides Flow Upstream Over River Water Forming Bore



Violent storm in the Bering sea piled this coastwise steamer high and dry on rocks off Alaskan coast.



U.S.S. Memphis, driven ashore by tidal wave which swept over sea from storm two hundred miles away.



"Bores," as illustrated here, occur when extremely high ocean tides flow in over water at river's mouth.

out of the hurricane area into regions undisturbed by the storm. On one occasion a tidal wave originating in the Caribbean, struck a Central American port and, finding the shipping totally unprepared, piled a number of ships up high and dry on the beach. Among them was the U. S. S. Memphis, a cruiser on duty in tropical waters. The Memphis is shown in an accompanying photo.

Florida, the Gulf coast, Central America, and the West Indies are frequently subjected to punishment at the hands of the tidal waves. Fortunately, however, a highly efficient weather bureau, maintained by the U. S. Government, enables shipping to keep informed as to the weather all through the tropics. Storm warnings are broadcast to ships regularly, so that they can make for deep waters when a storm approaches.

How Earthquakes Cause Tidal Waves

Submarine earthquakes occurring far out at sea account for many disturbances of the ocean surface which often pass as tidal waves. When old Mother Earth gives a rumble down in her innards, a section of the sea bottom subsides and a great mass of water comes pouring into the gap to fill up the space. Momentarily there is formed a pit of water immediately over the locale of the subsidence, but the momentum of the intrushing water quickly fills this hole up and in addition piles up a young mountain of water.

Now one of the first laws of nature is that all that goes up must come down, and when this mountain of water comes down it raises huge waves which radiate outward, spreading in concentric rings that run over the sea's face for hundreds of miles. The procedure has the appearance of that familiar series of rings which are generated when you throw a rock into a pond of still water.

These tidal waves are particularly vicious



Here is seen the bore in the mouth of the Petitcodiac river, which flows into the Bay of Fundy. Tide rising to 40 feet in height flows over the river water, moving upstream in a tumbling cataract of water three feet high at a 10 m. p. h. speed.

Hurricane Winds Beat Up Huge Waves Working Havoc on Coast Towns



Callao, Peru, has had occasion to know the destructive violence of tidal waves created by hurricanes. As shown here, whole water front was wrecked when wave struck in 1913.

when they strike a low-lying coastal city. One of the greatest disasters in history occurred when a tidal wave generated by a marine quake struck the city of Lisbon, Portugal, in 1755, almost completely destroying the city and snuffing out 50,000 lives. Having no warning whatever the city was taken unawares, with what terrible results, an accompanying drawing will show.

Tidal Wave Destroys City of Lisbon

Immediately after the quake occurred, the waters receded, leaving the mouth of the Tagus river bare. But then a few seconds later a huge wave more than 60 feet in height returned with full fury and swept over the city, tumbling down hundreds of buildings along the waterfront, smashing ships tied up to the wharves, and drowning thousands. When a series of smaller waves had reduced the city to a mass of wreckage, fire broke out and administered a "coup de grace." Over \$100,000,000 in damage was done.

Fortunately, tidal waves of this type can be anticipated and guarded against nowadays, thanks to the invention of a marine seismograph recently devised by an Italian scientist. The vibrations set up by the quake travel at a much higher speed than the tidal wave, so that when the former is detected in the seismograph, the latter can be expected to follow shortly thereafter.

Such an instrument installed in a Hawaiian city recently gave warning of a tidal wave to come. The populace scurried to the hills, from which point they watched giant incoming wave destroy their homes.

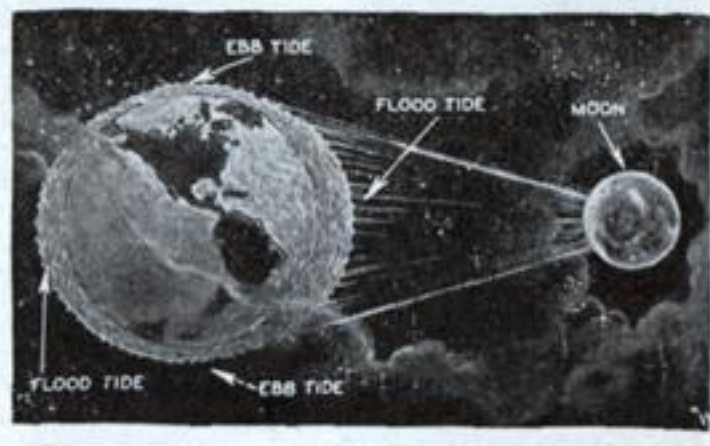
Inventions for January



Havana was submerged waist deep in water when storm tides from a hurricane struck the city in 1896.

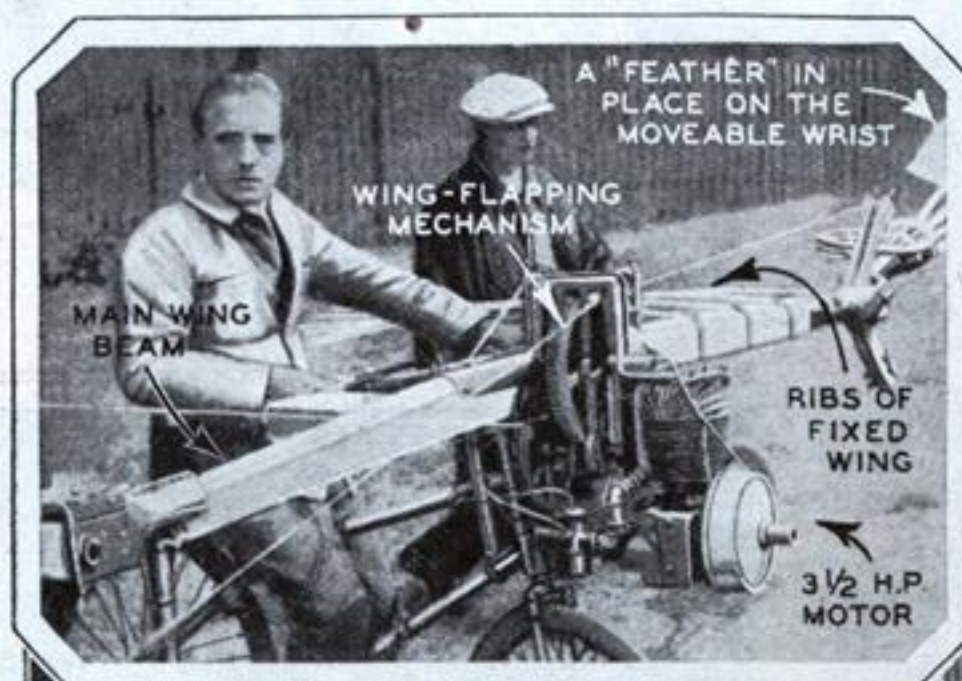


Hurricane which struck Florida in 1924 drove boats inland, smashed houses and tore down phone poles.

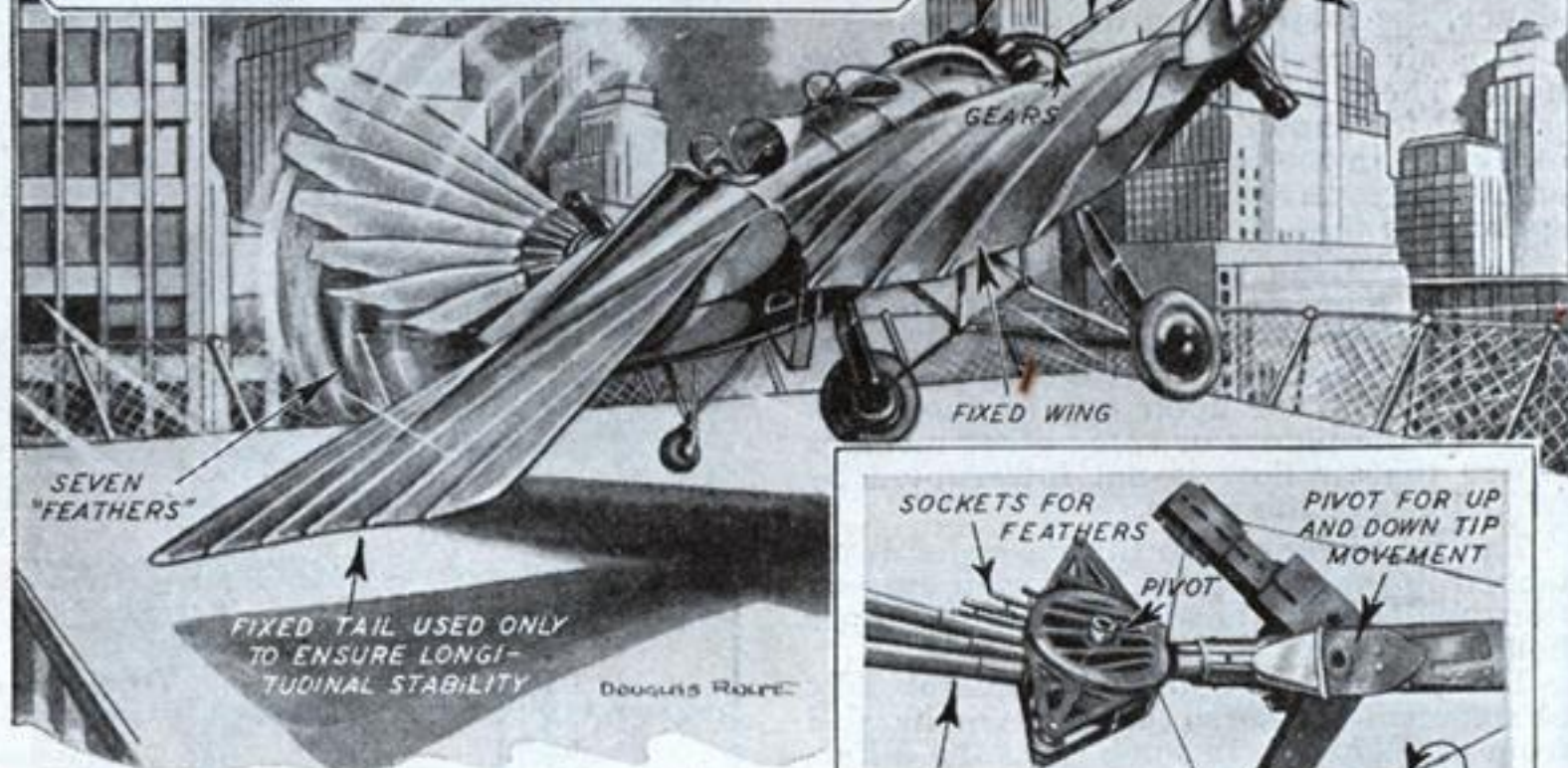


Real tidal waves are raised on earth twice daily by gravitational pull of moon, as illustrated here. The mound of water travels around the earth, lagging slightly behind moon.

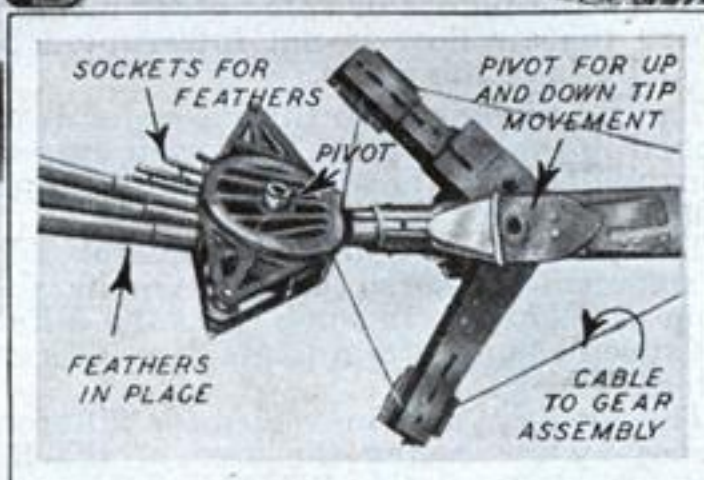
Why Wing-Flapping PLANES Won't Fly



At the left is shown Carl Czerny testing his experimental rig. It is claimed that the machine was easily lifted in tests.



Above is an artist's conception of a wing flapping plane of the type described here. At the right is a photograph of the "wrist" or link which connects the moveable and fixed wings. It is this "wrist" which imparts a rowing motion.



THE odd plane described here is just another manifestation of the wing-flapping idea which has cropped up periodically ever since man first considered the conquest of the air.

There is a certain brand of inventor obsessed with the idea that the only satisfactory way to achieve flight is by a literal application of bird-flight principles. To this class of inventor all present day aircraft appear completely unsatisfactory particularly in their use of airscrews rather than wing beats as a means of propulsion.

As a matter of fact, if the wing-flapping theory is tenable it would be just as logical to throw all modern boats into discard and replace them with ships driven with some sort of fin arrangement which followed closely the fish method of propulsion.

It is true that the study of bird flight has been of great value in the development of

human flight and it is probably equally true that man has still much to learn from this study, but the results of this study have shown, and possibly will continue to show, that the wing-flapping type of aircraft is not likely to be developed.

Even a superficial study of birds shows that most of the larger species are primarily not wing flappers, but soarers, and it is from this latter class that most of the beneficial knowledge has been obtained and applied to airplane design. All attempts of inventors to produce a practical wing flapping craft have signally failed, but apparently this is a class not easily discouraged.

One of the more promising developments in this line of aircraft is now being completed in Austria. The inventor, Carl Czerny, produced several working models before the war and was working on a full size

(Continued on page 178)

Will Grow Your Hair Or Cost Nothing

You all know Jack Slavin, formerly Middleweight Champion Boxer of Australia and America. He's now 65, but when he was 45 he was bald. See untouched photos at sides.



After:
Jack Slavin
At 65



Before:
Jack Slavin
At 45

When he was touring Asia the Sultan of Johore introduced him to a Hindu Prince who, in jest, attempted to pull the few straggling hairs that remained at his temples. Jack was angry, and to appease his anger the Prince handed him a formula, saying: "Here, this will grow your d... hair." Imagine his delight when it DID.

He has used this formula and treatment for 17 years with success on thousands of bald heads.

It is guaranteed to grow hair on your head, stop falling hair, eliminate dandruff and relieve itching scalp, or your money will be refunded—every cent of it.

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Wing-Flapping Planes Won't Fly

(Continued from page 122)

experimental ship at the time of his death. The results obtained from this plane encouraged the formation of the Austrian Wing-Flapping Aircraft Co., which is now engaged in continuing Czerny's experiments.

The Czerny plane shows evidence of a serious and carefully thought out plan to utilize wing beats not only as a means of forward propulsion but also as a means of controlling stability, steering, ascent and descent.

Realizing that the larger birds, particularly the soarers, do not derive their lift and forward motion by employing action of the entire wing but maintain a constant and sometimes almost imperceptible motion of the outer wing, Czerny embodied this principle in his design. Consequently it is only the tips of the wings that flap on the Czerny plane—the main wing being a fixed surface similar to that found on conventional planes.

Moreover there is an attempt to utilize the air pressure itself to assist the flapping action and thereby dispense with the excessive horsepower usually required to move the wings. A 3½ horsepower motor on the experimental plane proved sufficient to flap the wings and with only two "feathers" in place on each wing it is claimed that the plane lifted from the ground.

Briefly described, the Czerny plane resembles a normal ship in general appearance with the startling exception that it has neither propeller nor vertical rudder. The main plane has at each tip a peculiar wrist-like device in which are mounted, fan-wise, seven flexible single spar wings or "feathers," the longest of which is about 6 feet long. These "feathers," being quite flexible, automatically adjust themselves to air conditions, and the motion of the wing. This quality, combined with the peculiar action of the "wrist," enables the wings to be flapped and moved in a rowing motion without the use of excessive power.

The general action of the wings in flight is a flapping, rowing motion but either action can be used at the discretion of the pilot. That is to say, if for instance the plane has to be landed in a small space, the pilot can control the wing beats so as to curtail the propelling action and increase the up and down flapping to land in much the same manner as a bird. This wing action is connected to the motor through the "wrists" by cables and gears. The "wrists" themselves are the secret of the inventor and no information is available on how the action is obtained.

The pilot can similarly control the wing action to take care of steering and maintaining lateral balance. The fixed tail is not controllable.

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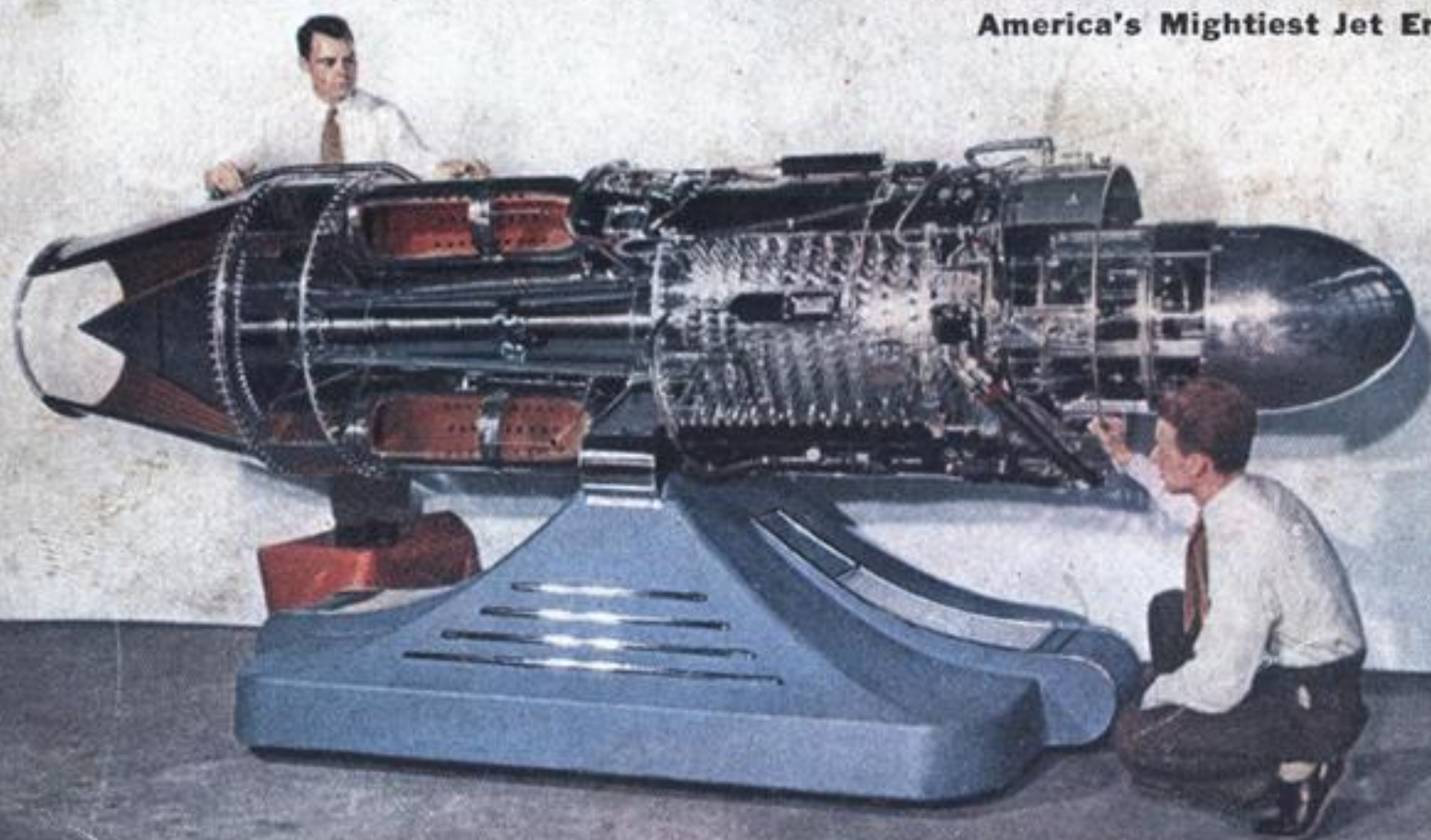
JANUARY



**Mechanized St. Bernard
Rescues Lost Skiers**

**SUNKEN GOLD LURES MODERN TREASURE HUNTERS
THE MYTH ABOUT SCIENTIFIC LIE DETECTORS**

America's Mightiest Jet Engine





Mechanized St. Bernard



Before the 100-hp St. Bernard rescued the injured boy, top of page, Lad Nichols swept the snowy terrain with binoculars. Over the Cat's wheel, below, is a compass, to navigate trackless snow.



A new breed of St. Bernard is making news for Steamboat Springs—a western Colorado winter resort—by rescuing skiers lost in the high Rockies. This latest hero of the snow, however, is not a canine but a cat—a novel, snow-traveling tractor invented and produced by Emmitt M. Tucker of Medford, Oregon, and known as the Sno-Cat.

Recently at the resort a young skier was reported missing. Lad Nichols and Laverne Nelson fastened a stretcher on a toboggan, then hitched it behind the vehicle. The Mercury-motored St. Bernard climbed easily up the rugged, white slopes of the mountains above the valley. Finally Lad spotted some tracks ending below a clump of trees and found the lost boy lying injured in the snow after a bad, twisting fall.

Key to the Cat's amazing agility over all kinds of snow and up slopes too steep (up to 65% for double-drive models) for any other motorized equipment is the sliding-pontoon traction. Open-linked tracks bite firmly into the compressed snow while the driving force slides the pontoons forward like a sled. On such a wide surface, the great Cat "steps" lighter than a man on snowshoes.

The mechanized St. Bernard, unlike his Alpine cousin, doesn't carry a neck cask and isn't very affectionate. But what it lacks in affection, it more than makes up in efficiency—by saving blizzard-bound cattle and making line repairs, as well as by rescuing skiers from death in the snow. •

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STILL **25¢** APRIL

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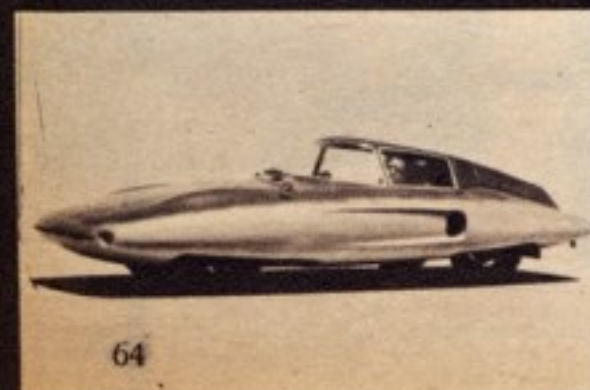
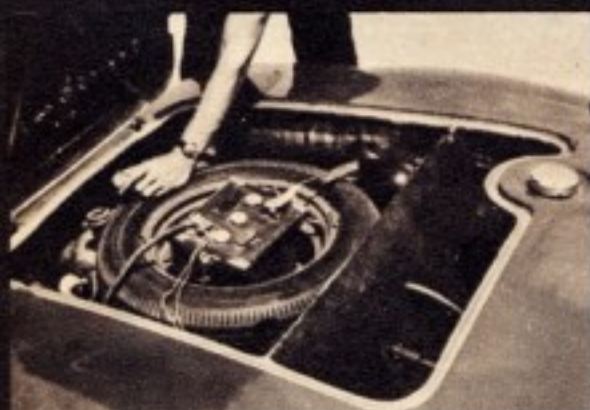
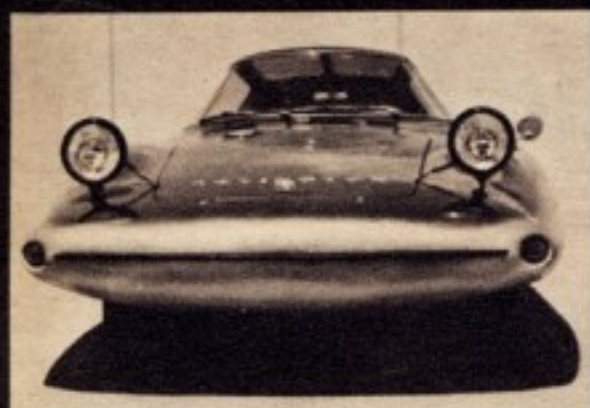


"THE SHARK" See Page 64

NEW ARMY COMBAT VEHICLE "WALKS" LIKE A MAN
WEEGEE TELLS HOW TO MAKE

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COVER STORY



CARS

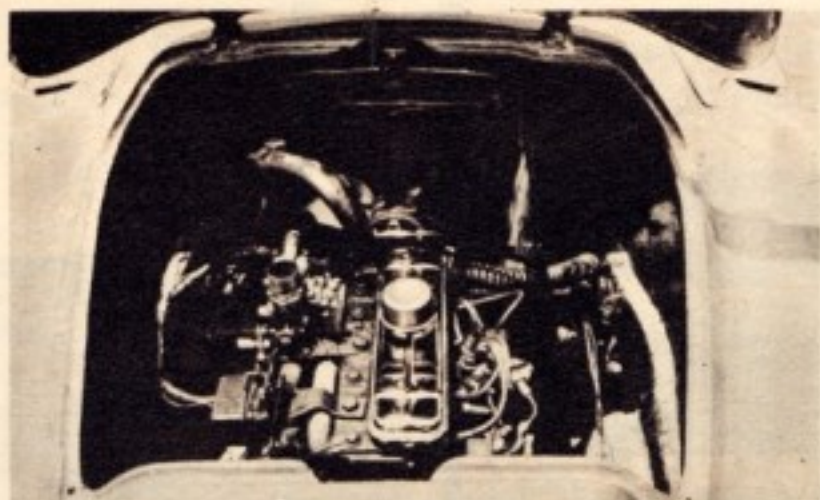
YOU'D LIKE TO OWN

THEY CALL IT "THE SHARK"

"AN aerodynamical, sculptured form on wheels" is how Henry Covington of St. Petersburg, Fla., describes the shark-like contours of the fibrous glass body he designed and mounted on the chassis of a 1950 4CV Renault. The Shark features removable headlights; gas tank, battery and spare tire under front hood; and air scoops on each side to eliminate overheating. It will do about 75 mph. The car was developed over a period of six years at a cost of \$4,000. Copies of the body are planned for production, will sell for about \$400 each. •



DRIVER tips steering wheel to right to enter.



REAR-MOUNTED 19-hp Renault mill gets 50 mpg.



DIMENSIONS: Wheel-
base: 82 in.; length:
159.5 in.; height: 42.5
in.; width: 73 in.; tread:
47.5 in. Hinged top can-
opy is raised when en-
tering and leaving car.



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MAY

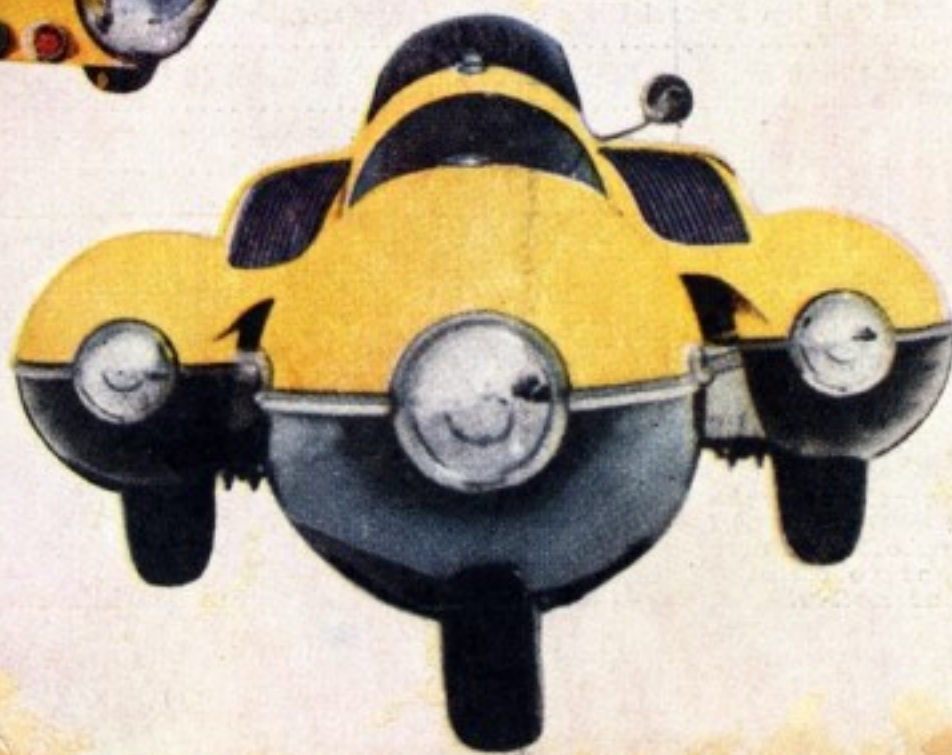
15¢



New hot rod has belly-tank body,
wingtip-tank fenders, aircraft
engine, does 110 mph—Page 84

Tom McCahill Tests
'52 Buick Roadmaster

Build Model PT Boat
Controlled by Radio



Draftsman Richard Harp shows his "sky car" to his wife. It cost him two years of spare time and about \$1,500.



Three-Wheel

TWENTY-five-year-old draftsman Richard Harp spent his spare time kicking around the airfields of western Maryland longing for any chance to bolt off into that wonderful wild blue yonder. It was only his new baby daughter and his attractive young wife which kept him from taking off from his drafting table for a career in the sky.

Since he couldn't zoom away at will, he decided to bring a bit of the wild blue down to earth for his personal enjoyment. And that's how he got started on his unique three-wheel hot rod. From the airfields he salvaged a big belly tank, two small wing-

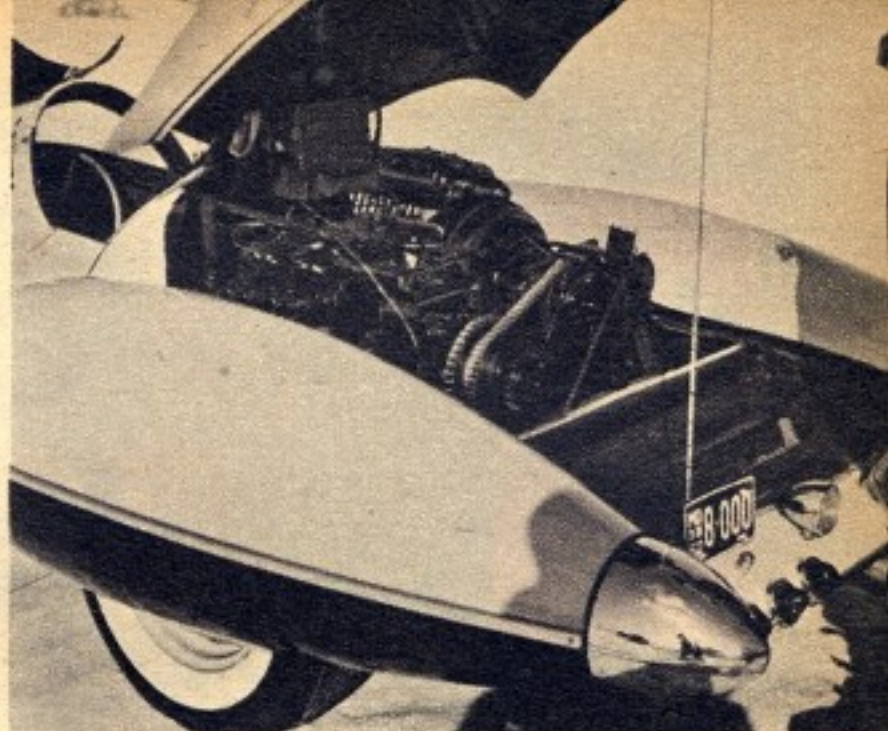
tip tanks and some Grumman aviation instruments. The belly tank he made into a streamlined chartreuse-and-black body with one seat in the red-plush cockpit. Each wingtip tank he converted into a housing for a wheel taken from a 1937 Willys, located toward the tapering tail of the body.

Like the modern tricycle landing on a jet, the nose of this fuselage holds a smaller special wheel, the third one in the three point setup of the car. He combined the aviation instruments with dials from a Chevrolet to form a flashy dash for his aero-auto.



Grumman aviation instruments and dials from a Chevrolet form the dashboard of this hot rod.

In order to change the 6.00 by 16 tires, Harp removes the fender skirts from the rear wheels.



Snap cover lifts up behind cockpit to reveal Lycoming engine with four opposed cylinders.

Nose of the fuselage holds a special small wheel much like the modern tricycle wheel on a jet plane.



HOT ROD

To hold these aircraft tanks rigidly together, Harp made up a frame of three-inch channel steel. For power he mounted a Lycoming aviation engine of four opposed cylinders on the rear axle. The power runs through a standard four-speed transmission from a Model 74 Harley-Davidson and drives the rear wheels by roller chains.

Harp's hot rod cost him two years of nights and weekends and some \$1,500 in cash. The sporty three-wheeler contrasts dramatically with the staid family car Harp usually pilots around town—a Buick Super sedan. Length of the lowslung little home-

made job is 14 feet, 6 inches. Weight is about 1,600 pounds—or about a dollar a pound in costs.

After driving the family bus, Dick gets a real thrill every time he hops into his single-seater for a "flight" down the road. He can do a smooth 80 mph—in second! Since there are no safe straightaways for speeding in his area, he has never yet pulled the gun on his hot rod. But, he estimates it will do 110 mph. Should the engine start heating up at such a speed, he can easily hook a belt and a fan to his engine for greater cooling. And he averages 20 miles to a gallon. [Continued on page 171]

MECHANIX ILLUSTRATED

THE HOW-TO-DO MAGAZINE

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HOME-BUILT
HUNTING CAR
TOPS 60 MPH!



Extra! WHERE TO BUY
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EIGHT-WHEEL HUNTING WAGON COST ...

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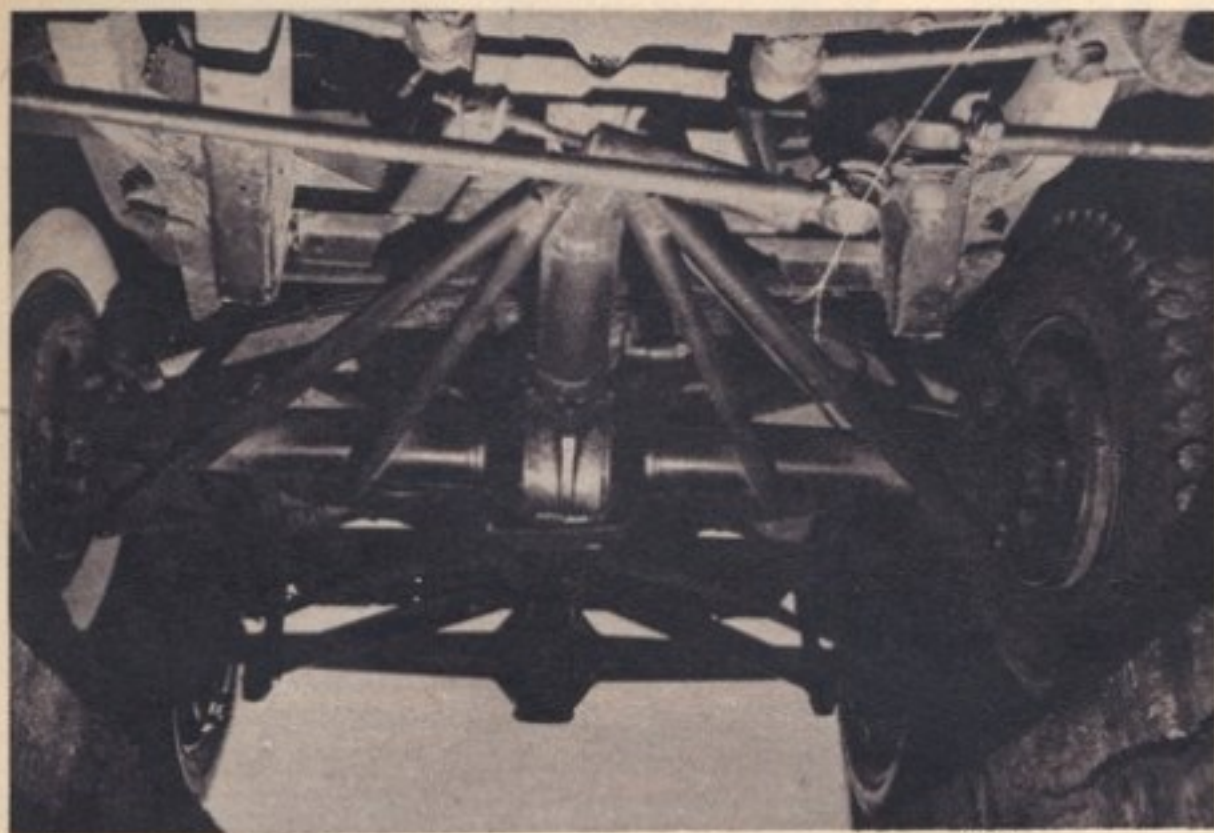
December 1961

\$200

WAGGISHLY dubbed "The Purple People-Eater" is a crazy eight-wheeled prairie buggy built by Melvin Gould, 31, a farmer-mechanic of Cheyenne, Wyo. Mel—an avid hunter—designed the machine to carry him into the nearby Rocky Mountain foothills where deer and antelope abound. He built the Eater in a little over 12 months of spare-time work with an investment of \$200. The car is made mostly from Ford parts, vintage 1940. She's powered by a four-speed V-8 engine from a Ford pickup. The body is a Crosley station wagon with the top cut off.

CONTINUED . . .





UNDERSIDE view of PPE showing steering and suspension systems.



The buggy gets her drive from a special straight-line power take-off from the transmission to both rear axles. Double-axle steering permits the four front wheels to turn together. All axles are independently suspended to allow at least one set of steering and drive wheels to be on the ground at all times regardless of the terrain.

Considering her weight (3,500 lbs.), PPE is fast, highly maneuverable and gutty. She can get up a 65 per cent incline, hit up to 60 mph on the open road or pace a buck antelope overland at 40 mph. And she can turn on the proverbial dime.

Mel has been operating the Eater for over a year now. He's had it out in all kinds of weather, through mud and snow and over some of the roughest country in the West—and (so far) without a serious mechanical breakdown. "The Eater is tough," he says. (And we believe it!) •

◀ **HEAD-ON** the Eater looks like any other stock car. Her top highway speed: 60 mph.



ON A PRAIRIE romp with his dog, Mel demonstrates action of PPE's suspension system.



SYNCHRONIZED steering turns four front wheels in concert. Traction from two extra wheels permits terrific maneuverability.

MEL deflates the tires to about 12 lbs. prior to making an overland run; their normal pressure for highway travel is 28 lbs. (No, the dog has never fallen off.)



Race of the Century!

By Bruce Wennerstrom

WHAT has to be the ultimate motor-car race of all time is set for the Bonneville Salt Flats next year. Speed titans Gary Gabelich and Craig Breedlove, world Land Speed Record king and deposed king, will hold a wheel-to-wheel match race in rocket cars that for the first time on land will go through the sound barrier. The winner will take away half a million dollars.

Breedlove's mount will be the Spirit of America, Sonic II, a slim missile propelled by a 35,000-lb.-thrust engine derived from the descent stage of the Apollo lunar module.

In a parallel lane just 150 yds. away, Gabelich will be roaring alongside in another three-wheel bomb known as the Courage of Australia. (In our artist's illustration we had to put the cars closer together than they actually will be in order to show both of them.)

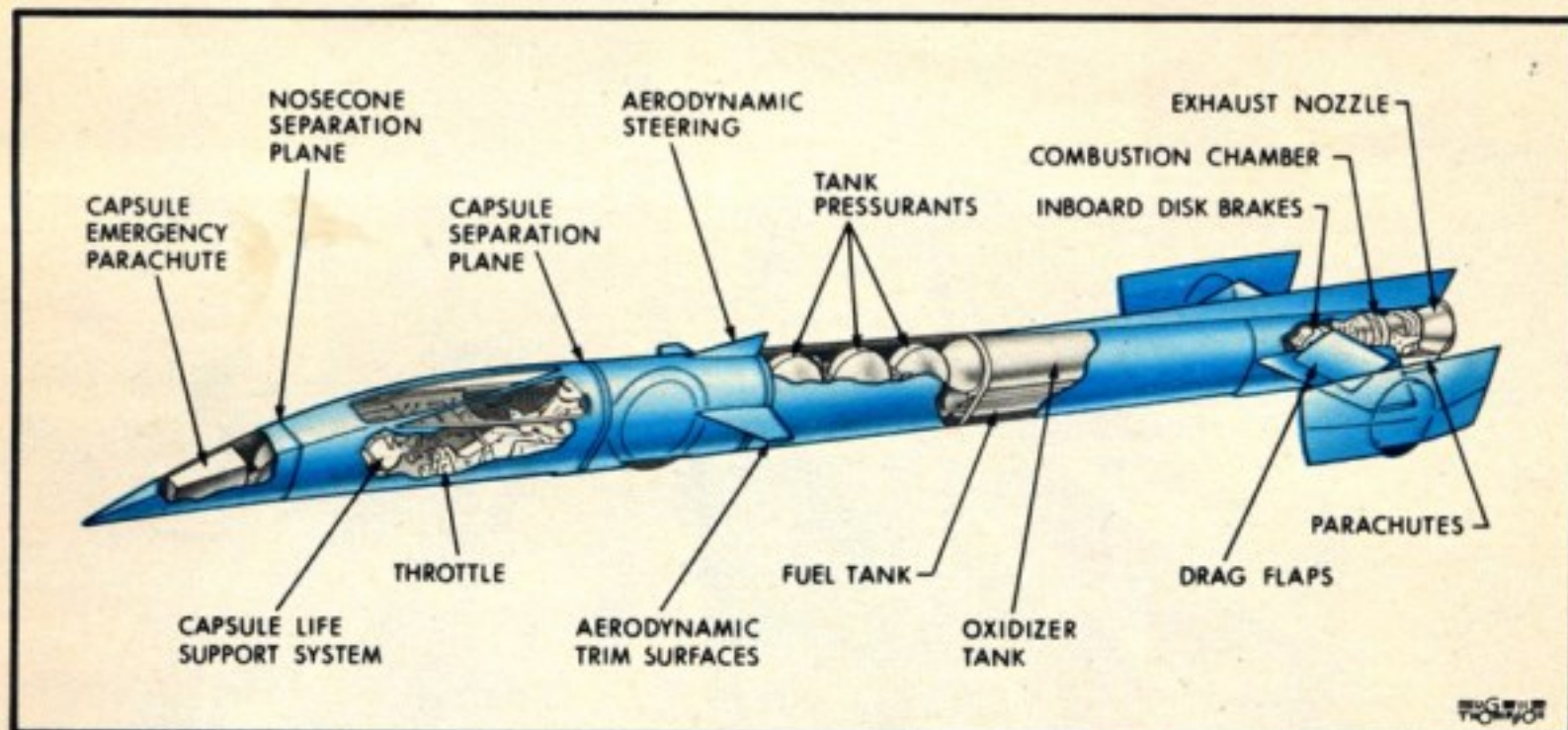
If the race comes off right it will be a dazzling technological feat



Race of the Century!



SPIRIT OF AMERICA, Sonic II, with Craig Breedlove at controls, will duel for half-million pot. Drawing shows main components.



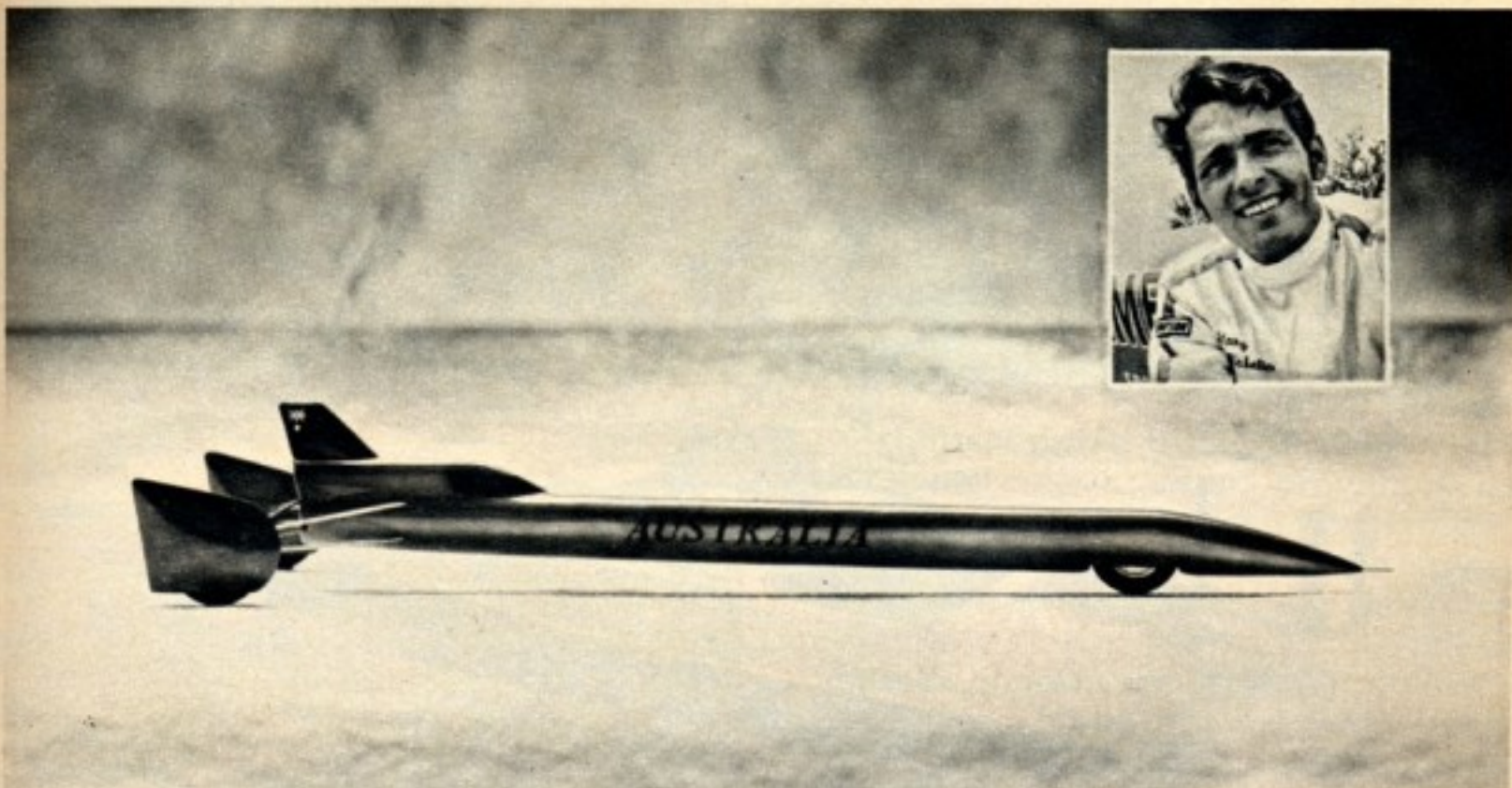
as well as a spectacular piece of show biz. The exact date for the big shootout has not yet been chosen but it is likely to be in October 1973 because conditions for ultra-high-speed runs are best at that time of year on the Salt Flats.

Promoting this way-out event is entrepreneur Bob Kachler, who has made arrangements with the State of Utah for the right to stage what he has designated The Bonneville Challenge Race, hopefully on a continuing, annual basis. Kachler visualizes the race as an international event similar to the America's Cup series in sailing that will attract entries from all over the world. In anticipation, Kachler has formed the Na-

tional Racing League (NRL) to handle the opus.

Overtones of the Cold War already have developed. Breedlove has obtained a photo of a Soviet LSR vehicle that looks like the real McCoy. The thought that the Russians might raise the LSR through the sound barrier first has added a sense of urgency to Breedlove and Gabelich plans.

Pursuit of the Land Speed Record has occupied Breedlove's entire adult life. At 21 he was at work on his first LSR vehicle—three-wheel and jet-powered—and the passion hasn't dimmed with the years. Right after setting his record of 600.601 mph in November of



COURAGE OF AUSTRALIA, Gary Gabelich's rocket steed, is a bit less sophisticated than the Spirit but speed potential is enough to carry it through speed of sound at Bonneville.

1965, Breedlove approached United Aircraft to obtain an RL-10 rocket engine, convinced that he could build a car that would penetrate the sound barrier.

Sponsor money was not forthcoming, though. Goodyear, who'd picked up most of his bills as prime backer, was unwilling to commit new funds simply to raise its own record. Breedlove was an unhappy man when Gabelich finally took the title away from him on Oct. 23, 1970, in the rocket-powered Blue Flame with a pair of runs averaging 622.407 mph. Those runs, incidentally, were made one day before the *Mechanix Illustrated* crew, which included this writer, arrived at Bonneville with the Silver Eagle for an assault on the *electric* Land Speed Record which a year later ended in success with a new mark of 146.437 mph.

Gabelich was long gone toward Los Angeles for interviews, television appearances and wining & dining when our gang came on the scene but the Blue Flame was still sitting impressively on the Salt. Sitting not too far away in California was the glum deposed king, Craig Breedlove. He was unhappy but determined and he vowed silently to regain the LSR laurel. He's never backed

down until now the record has become an obsession with him.

Gabelich at an early age made a similar commitment to high-speed motor-ing. In 1959, having just turned 19, he guided Bill Fredrick's jet car, *Val-kyrie*, through Bonneville's measured mile at 356 mph and his name has been in the news with regularity ever since, culminating in his epochal ride in the *Blue Flame*.

While Breedlove is wearing all the hats as his own project-design engineer, constructor, fund-raiser and driver, Gabelich's car is being built by Bill Fredrick.

For the record, it was Gabelich who threw out the challenge to Breedlove for a match race with a big purse. The half million is being raised through sale of film and television rights. That little detail, however, like many about the race, needs to be finalized. Nevertheless, no one who is familiar with the past performances of those concerned can doubt that, sooner or later, on some thin dawn Gabelich and Breedlove will be out there on the surrealistic Bonneville landscape, awaiting the countdown for the greatest race of all time.

[Continued on page 152]

Race of the Century

[Continued from page 65]

Until now, pursuit of the Land Speed Record has always been a solitary quest. From 1898, when the Count de Chasseloup-Laubat set the first LSR of 39.24 mph for a flying kilometer in the electric-power Jeantaud, to Gabelich's record runs in 1970, there has never been a wheel-to-wheel race of LSR contenders.

Certainly there have been rivalries as intense as the current Breedlove/Gabelich competition, however. De Chasseloup-Laubat held his record less than a month before he lost it to a Belgian, Camille Jenatzy. The Count took back the title the same day; the two men exchanged it three more times over the next several months in a furious rivalry.

But neither they nor such later contenders as Malcolm Campbell and de Hane Seagrave or John Cobb and George Eyston or Breedlove and Art Arfons ever dared run wheel-to-wheel.

And now that man finally is on the threshold of crossing the sound barrier on land and entering the transonic region of unknowns and unpredictables, two men and two cars will go through it together.

Breedlove and Gabelich are talking about trying for 1,000 mph, which would be well beyond the speed of sound. The Salt Flats lie more than 4,000 ft. above sea level and in the fall of the year it gets cold there at night. The mercury is still low early in the morning. LSR runs usually are made at the crack of dawn when there's little wind and the salt is dry (the water table under this dry bed of an ancient salt lake is just below the surface and may rise enough to wet the surface after sunup).

A temperature of 40°F would not be unusual for an October morning on the Salt. (As a matter of fact, during the stay of MI's Silver Eagle team in 1970, we turned out for breakfast one morning to find 12 in. of snow lying on the landscape.) Temperature is the variable that controls the speed of sound: hotter is faster, colder is slower. At 40° the sonic barrier would lie around 750 mph for Breedlove and Gabelich.

Both drivers are extraordinary men, eminently qualified for the task they've set for themselves. The men—and their machines—are remarkably similar in outward appearances. Breedlove, for instance, and Gabelich (until his serious crash last May) are both in the habit of putting in intense 18-hour days on their cars. Breedlove at 35 is four years older than Gabelich and Gary has twitted him about the age differential. He calls Craig the Old Man and talks of rocket-powered wheelchairs. But Breedlove guards his physical condition. Both men jog regularly. Craig's extra years may, if anything, be an advantage. They represent a four-year edge of knowledge.

The three-wheel cars have single, steerable nose wheels within the fuselage and faired (covered) outrigger rear wheels. The Blue Flame ran with bared wheels when Gabelich drove it to the record. The design decision was based on wind tunnel data which, surprisingly, indicated that wheel fairings would add drag. It is Breedlove's opinion that the data were improperly interpreted so he designed his new Spirit with faired wheels. The Courage also has faired wheels. Both cars are 44 ft. long with fuselages that are narrower at the bottom than at the top and have a forward rake to minimize the effect of shock wave rebound from the ground. Both have vertical fins for directional stability. Both use rocket power.

While the external configurations may be broadly similar, the design particulars are not. Breedlove's cockpit, far forward of the nose wheel, is a jettisonable capsule that includes a life-support system. The sloping windshield functions as an aerodynamic loading plane to help glue the big bird to the ground when it's underway. The capsule, built by Bell Helmets to Breedlove's specifications, is, he says, "essentially a big crash helmet. It's a glass shell with crushable foam lining and then upholstery. The Hi-Shear Corp. is going to provide the pyrotechnics for the separation of the capsule and the chute release. The separation will be driver's option."

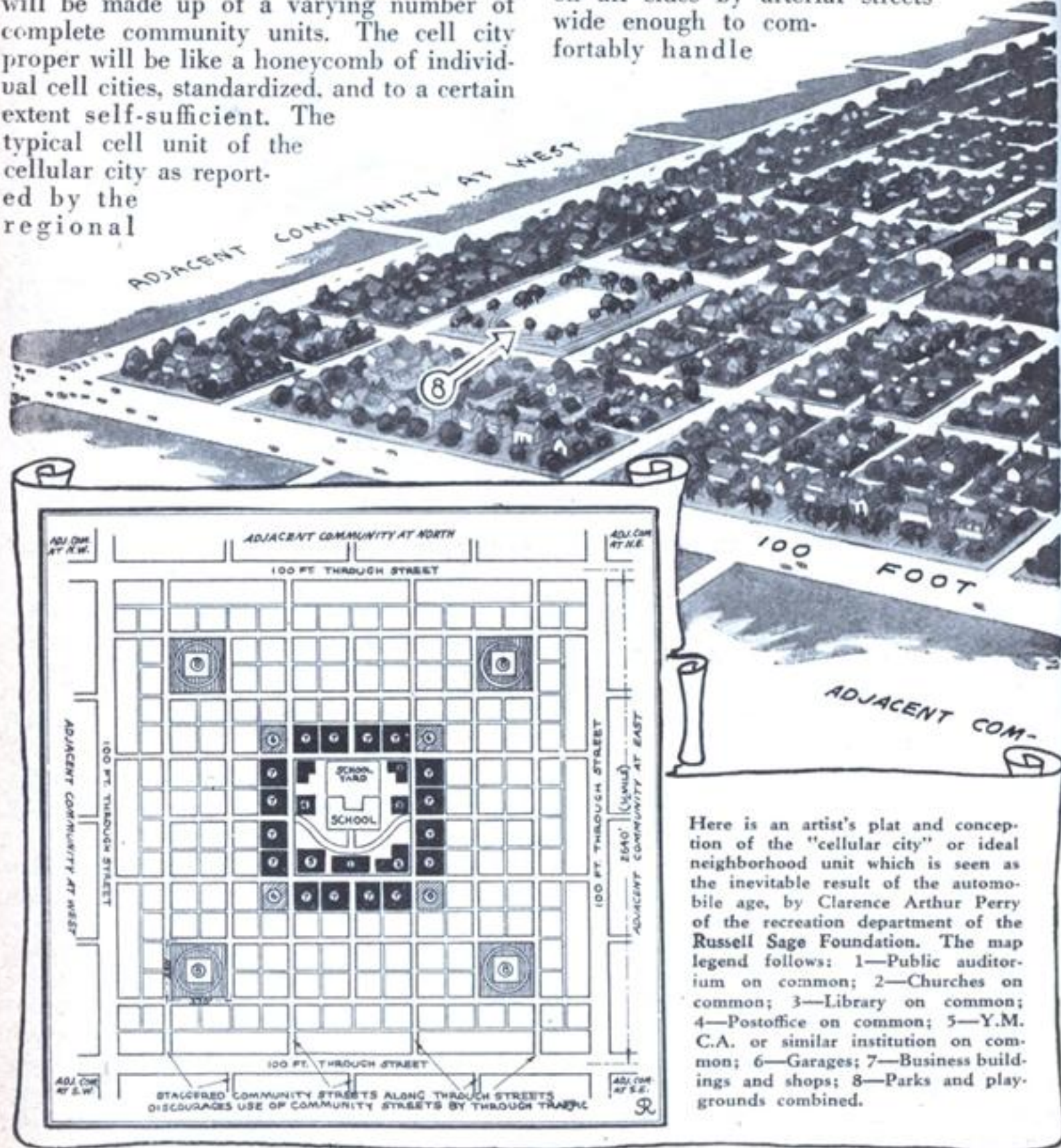
The far-forward location of Breedlove's cockpit is controversial for without the length of the fuselage for refer-

CELLULAR CITY

HIGHLY modernized cellular cities are predicted for the future by the Regional Plan of New York and its Environs based on a 5-year study by Clarence Arthur Perry of the recreation department of the Russell Sage Foundation.

The cell city which is seen by Perry as the inevitable product of an automobile age will be made up of a varying number of complete community units. The cell city proper will be like a honeycomb of individual cell cities, standardized, and to a certain extent self-sufficient. The typical cell unit of the cellular city as reported by the regional

plan would be a residential development providing housing for a population requiring one elementary school. The actual area of each cell would depend on density of population. This "cell" would be bounded on all sides by arterial streets wide enough to comfortably handle



Here is an artist's plat and conception of the "cellular city" or ideal neighborhood unit which is seen as the inevitable result of the automobile age, by Clarence Arthur Perry of the recreation department of the Russell Sage Foundation. The map legend follows: 1—Public auditorium on common; 2—Churches on common; 3—Library on common; 4—Postoffice on common; 5—Y.M.C.A. or similar institution on common; 6—Garages; 7—Business buildings and shops; 8—Parks and playgrounds combined.

of TOMORROW



An ideal regional community unit like the above with recreation spaces protected from hazardous auto traffic is planned for the future by experts.

all through traffic. The "cell" would include its own system of small parks and recreational spaces, large enough to accommodate the population of the cell only.

Sites for the school, postoffice and other service institutions would be grouped in the center of the "cell." One or more shopping districts adequate to serve the population

of the neighborhood unit would be located in the circumference of the "cell," preferably at the traffic junctions and adjacent to similar districts of adjoining neighborhoods each laid out on the same general scheme.

The unit should be provided with a special street system, each highway being designed to facilitate circulation.

My New Dirigible



Lieut.-Commdr. C. D. Burney, C.M.G., R.N., noted English aircraft designer.

Commander Burney, world authority on dirigibles, presents this revealing story of a startling new idea in lighter-than-air craft. Squat, elliptical, double hulled, hangarless—seagoing and self sufficient, the new ship on pontoons conceived by the designer of the R-101, is the solution to profitable ocean passenger trade.

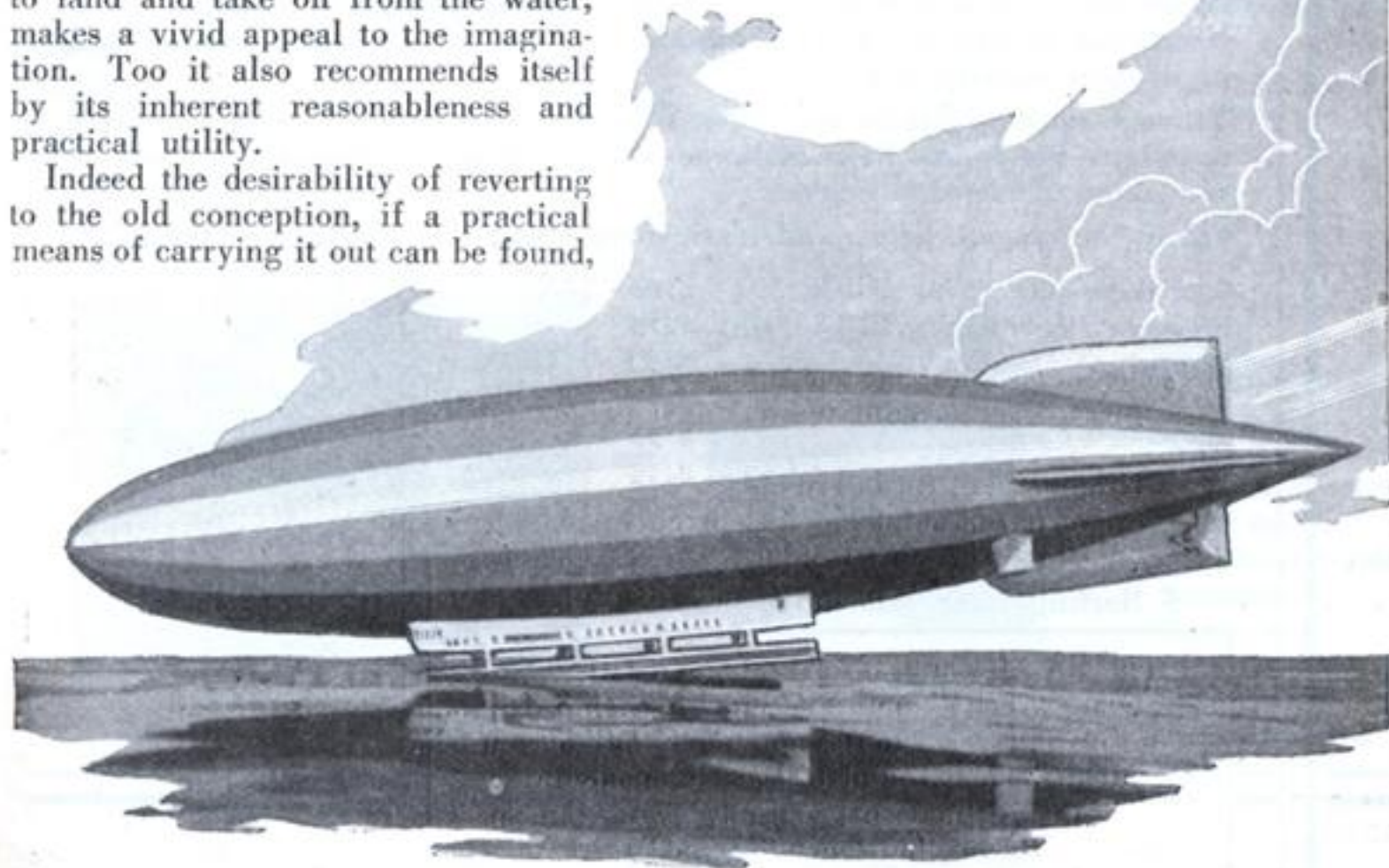
A DIRIGIBLE on pontoons may seem, at first thought, a startling innovation. But it is not. It is a reversion to the first conception of the airship. The first Zeppelin and the British Mayfly were both designed to operate from the water. The first designers, however, had not hit upon the elliptical shape which would seem necessary to give stability to such a vessel in face of side wind pressure.

The conception, however, is a fascinating one. The idea of enabling dirigibles to land and take off from the water, makes a vivid appeal to the imagination. Too it also recommends itself by its inherent reasonableness and practical utility.

Indeed the desirability of reverting to the old conception, if a practical means of carrying it out can be found,

has long been apparent to dirigible designers. The question of its possibility has now become the most urgent problem in airship construction and I think I have devised the kind of vessel required.

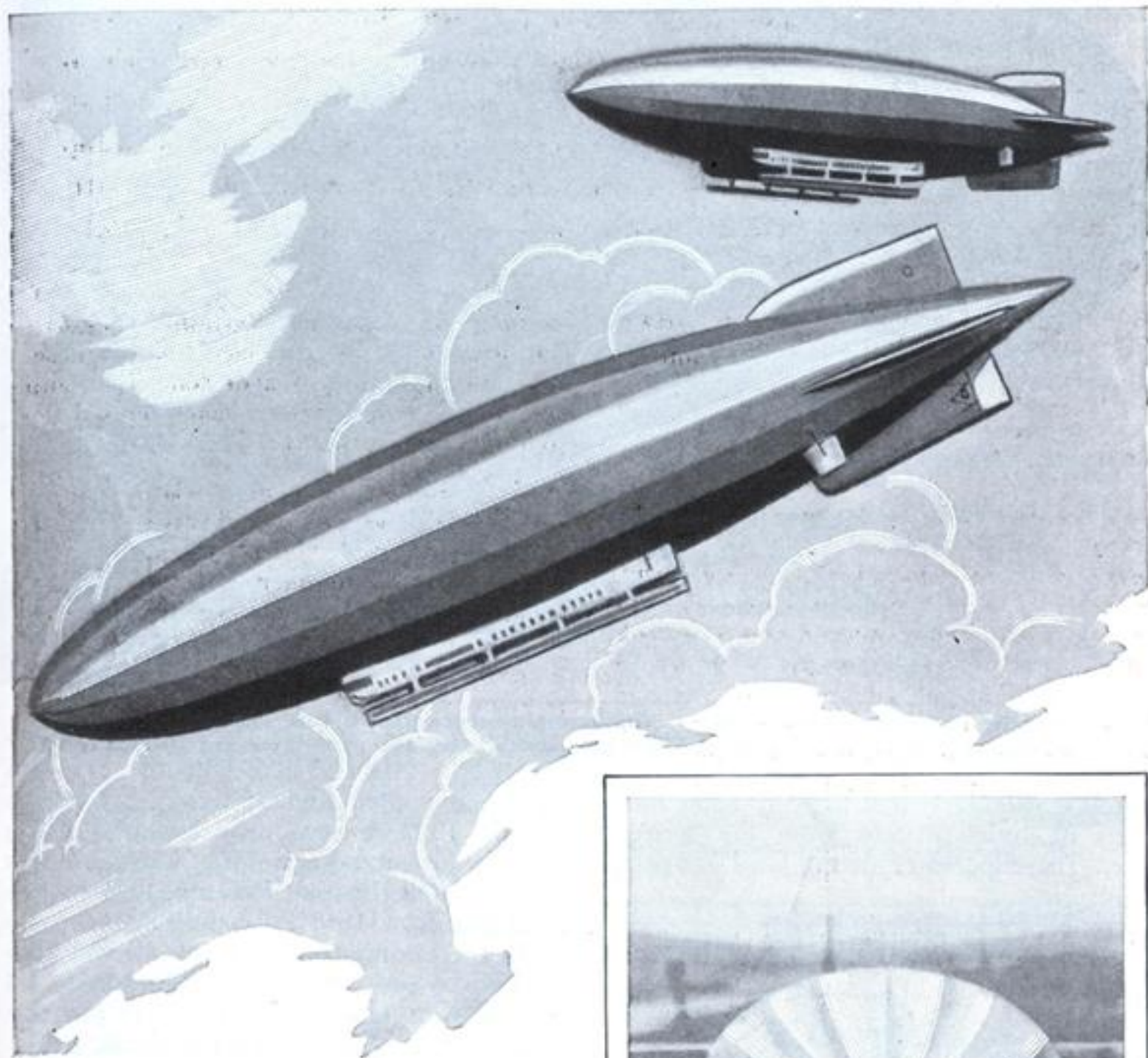
The important question is: Can the dirigible be put to effective use commercially? Unless it can, the case for development falls to the ground. The fact that we can now build dirigibles capable of the magnificent performances that stand to



This shows how the new British dirigible approaches the surface under power, scooping up 120 tons of water ballast which, without need for valving, without loss of gas, will hold the ship at rest.

on Pontoons

by Lt.-Cmdr. C. D. BURNEY
Designer of Britain's Giant R-101



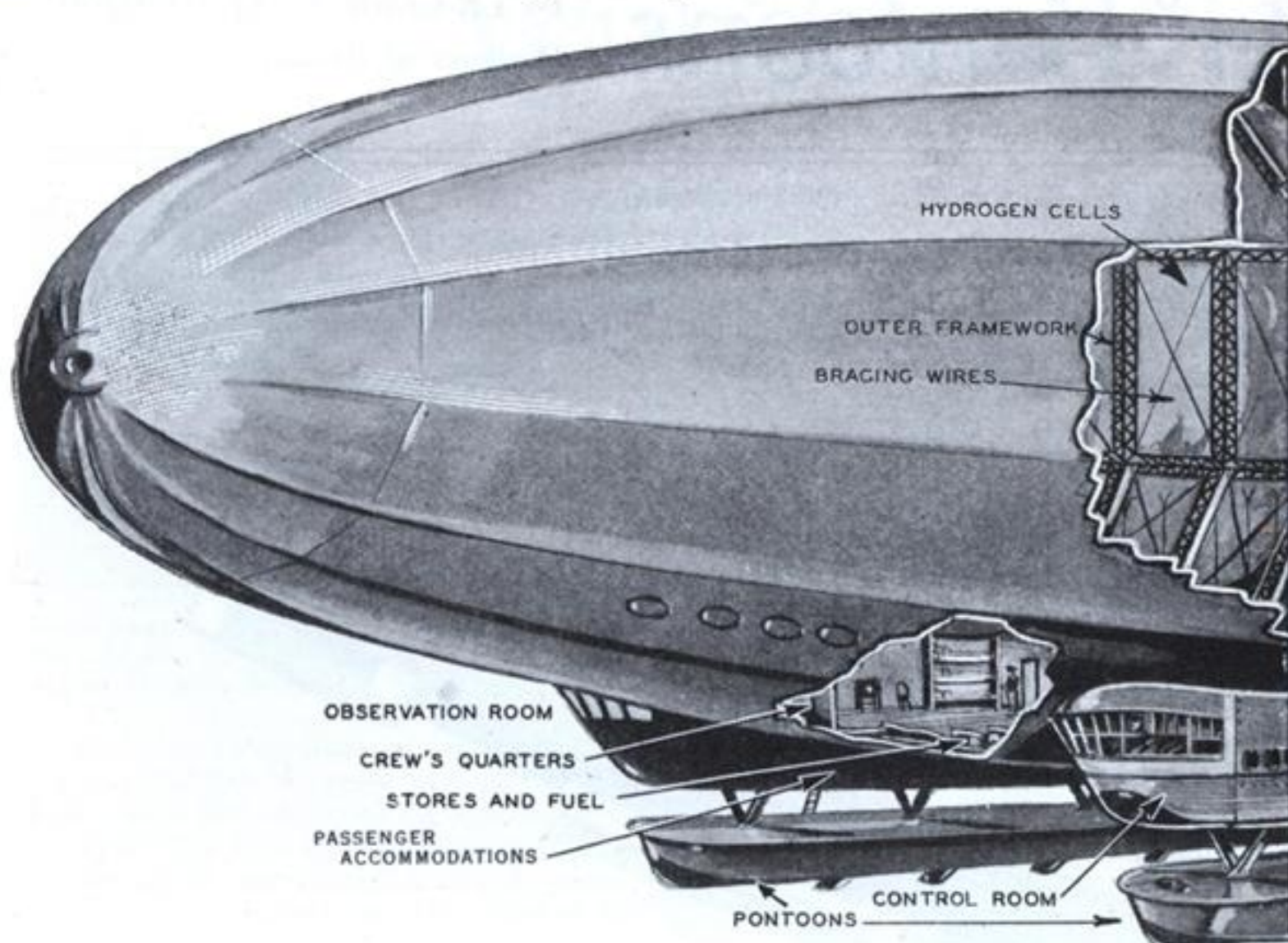
the credit of the Graf Zeppelin and can be anticipated from the British R101 and the R100, does not necessarily mean that it is worth our while to do so. The modern dirigible undoubtedly marks a great technical achievement. But that is not enough to justify its existence. It must, like any other technical invention, be able to pay its way commercially.

The dirigible as at present designed does not fulfil all the requirements of a commercial vehicle. To begin with the dirigible can only make a landing at a specially prepared base. This means that engine trouble or other misadventure may be very serious



The new egg-shaped, double hulled dirigible is driven toward the surface by her engines, losing no costly gas. The twin hulls pick up 120 tons of sea water each, securely anchoring the ship. Being elliptical, side windage is minimized.

Practical Commercial Passenger Dirigible Now Assured by Economical

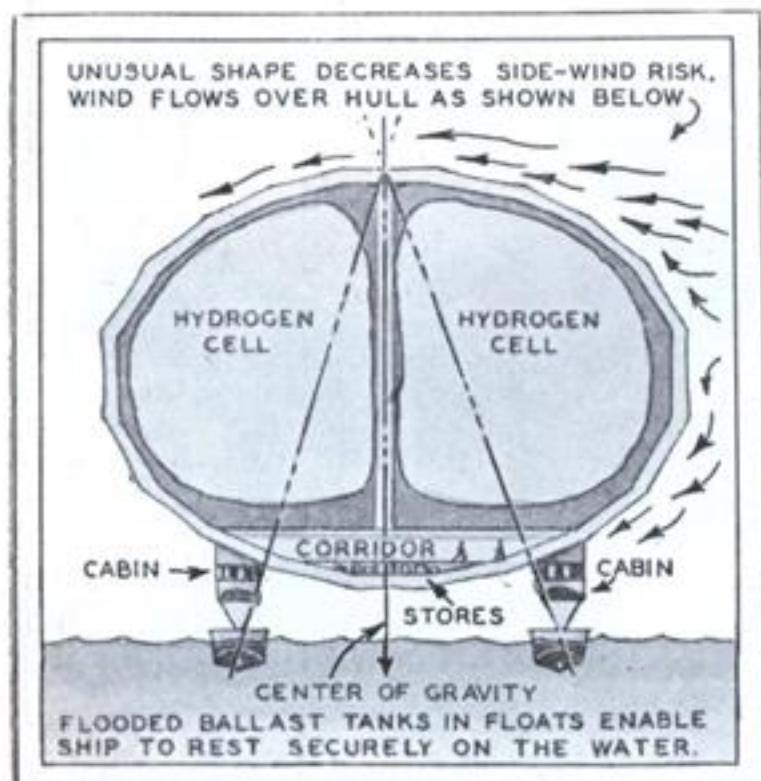


Plans are under way for a ship of 350 ton displacement—more than double any present ship. It is to have a range of 7000 miles at a speed of 100 m.p.h. It will carry 150 passengers and 20 tons freight.

indeed, particularly if it happens some hundreds of miles distant from the nearest base. The experience of the Graf Zeppelin

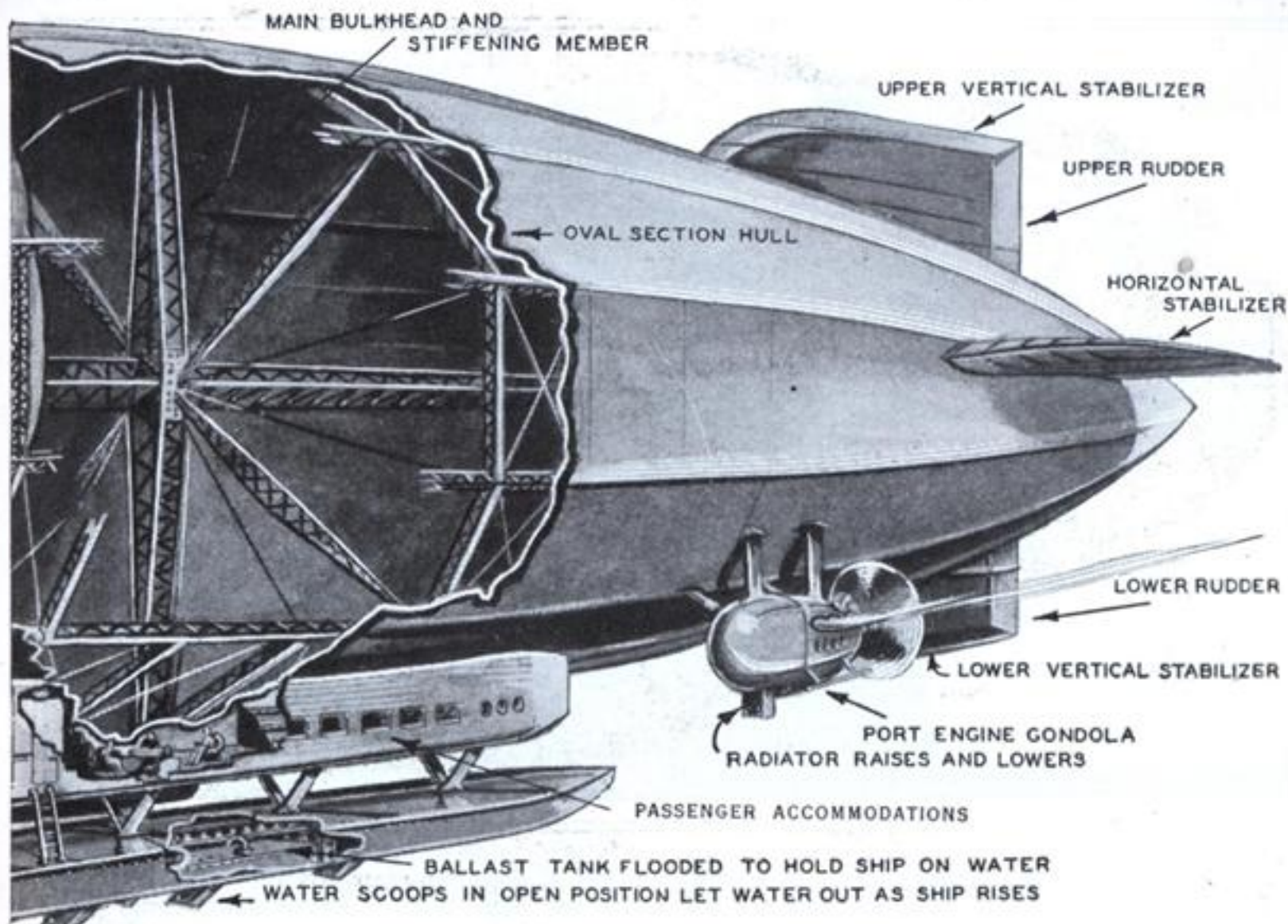
in her attempted flight across the Atlantic in May, 1929, is a case in point. The ship's engines broke down, and it was with the greatest difficulty that she managed to get back in safety. It is quite clear that so long as these conditions obtain, it will only be possible to run a regular airship service on a route with sufficient air traffic to pay the cost of erecting frequent intermediate bases.

There is the additional fact that the mooring and docking of airships is, at present, an exceedingly difficult and expensive operation. The ship has first of all to be moored at a mooring mast—an elaborate structure which costs a great deal to erect; and may have to wait some days in this position before the direction of the wind permits docking in the hangar. Nor is this all. As the dirigible can only be handled by manpower, the actual operation necessitates the employment of several hundred men in the ground crew, who have to stand by for the purpose. The mooring and docking raft idea, which we devised at Howden during the building of the R100, will, I think, pro-



The egg-shaped section has far less wind drift than a round one. Note extreme stability due to the wide placing of the hulls, assuring safety.

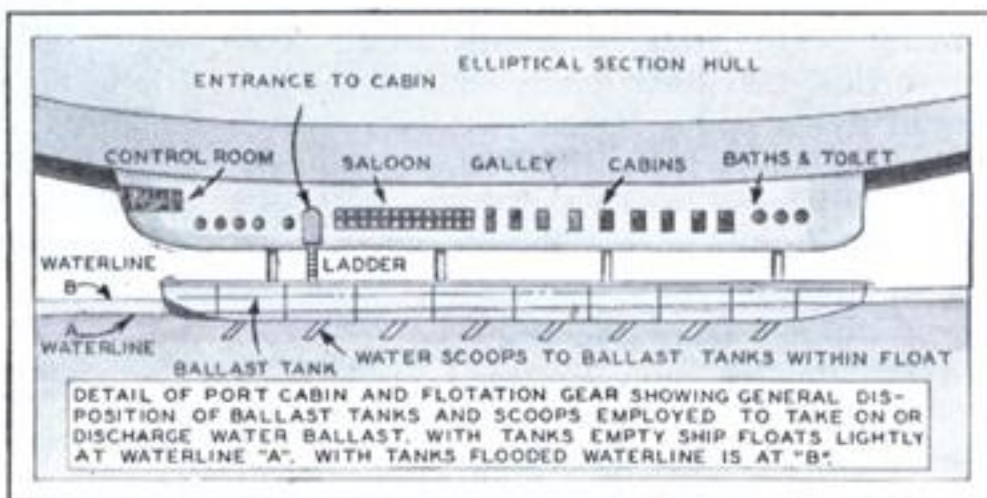
Dirigible Needing No Hangar, Losing No Gas, Using Minimum Crew



vide a practical solution to this difficulty. But the first difficulty of landing, except at a base specially prepared to receive her, still remains. And it is quite certain that this will never be overcome so long as airships can only operate on land. They must be made to operate from the water as well.

The problem that lies before us is how to re-design dirigibles so that they will be able to come down in the manner of a flying boat and be moored to a buoy or lie at anchor like a marine vessel. I think that it is technically possible to construct an air-ship of the type suggested.

The design which I have recently worked out, has passed preliminary model tests so satisfactorily as to leave little doubt about the practicability of the conception. A full description of my proposed new dirigible pontoons is contained in my book, "The World, the Air and the Future." All I can do here is to touch briefly on its salient points. The accompanying illustrations show

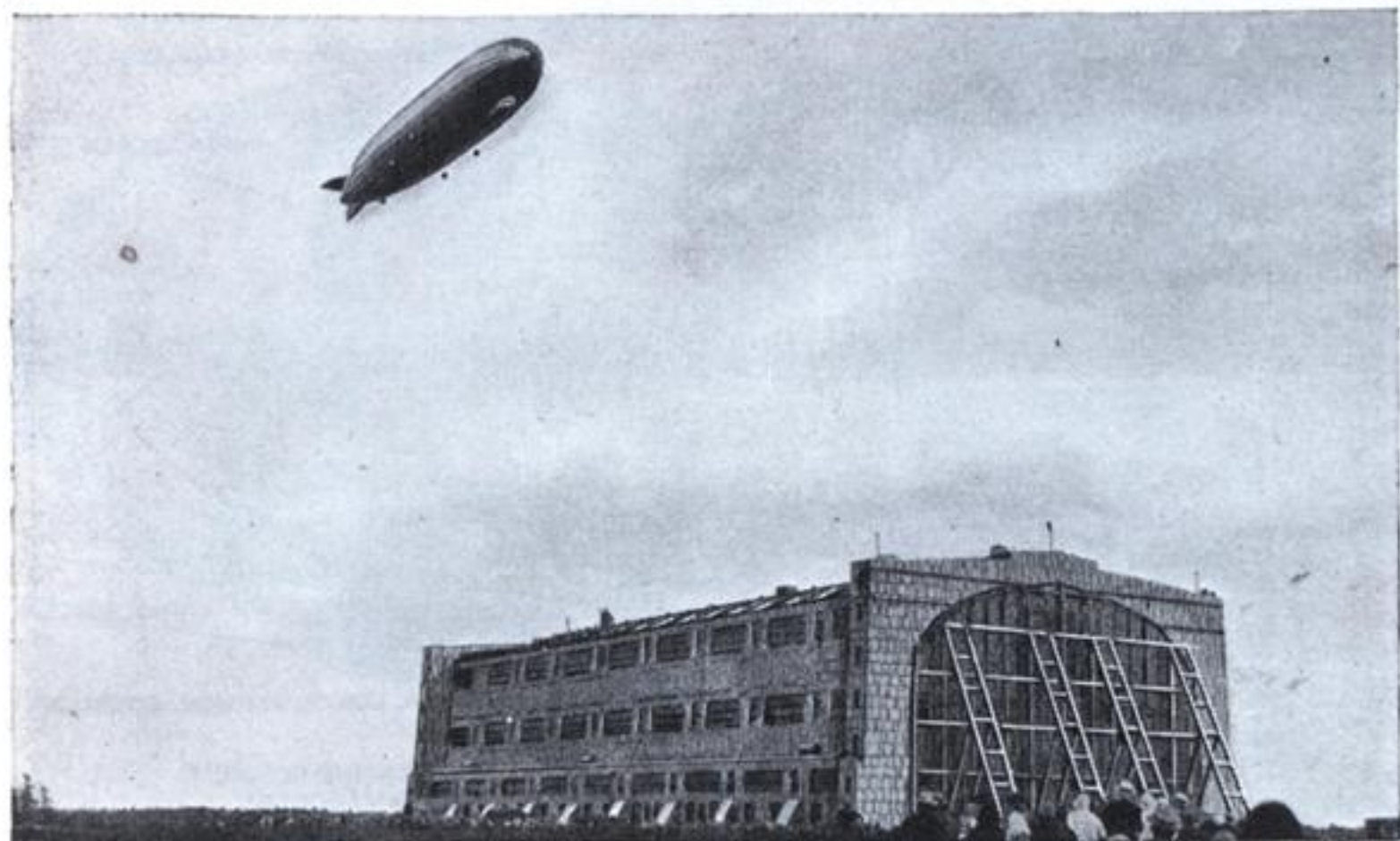


Loss of costly, buoyant gas is one reason why dirigibles do not pay. Burney's invention minimizes gas loss. The ballast hulls scoop in water, keeping the ship securely on the surface when it is driven down to the surface under engine power. Opening the sluices dumps the water, and the ship rises as shown in the cover painting on this issue. There are accommodations for 150 passengers in the spacious twin hulls.

the model in various moments of operation and give some idea of the shape of the ship and of method of control.

The basic idea of the new pontoon-equipped dirigible is to enable it to land at unprepared places. Our object is to keep the ship under dynamic control by means of rudders and elevators, until it can be securely held, and is no longer in danger

Costly Maintenance Charges, Hangars, Done Away With in Burney Ship

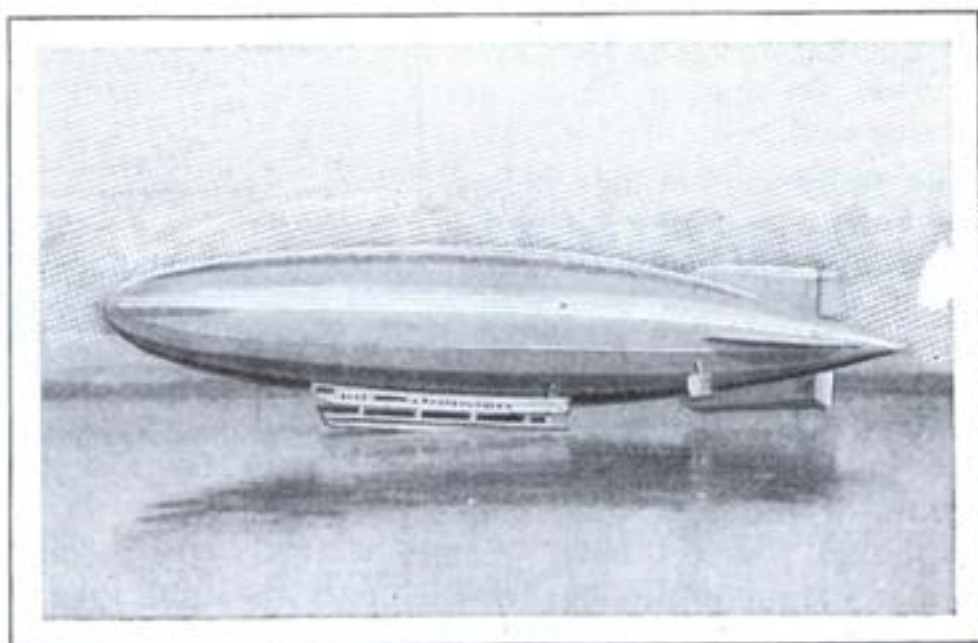


To bring trans-oceanic dirigible service within the reach of travelers many of the costly needs of today must be eliminated. Hangars and ground crews are done away with in the Burney type.

of being blown over by a side wind. To achieve this, two long floats, similar to the hulls of flying boats, but much larger, were constructed under midship. These are fitted with ballast tanks, and fixed to the hull, as far apart in a transverse direction as possible. At the same time the section is altered from the standard circular to an elliptical section. This reduces the overall height and lessens resistance to side winds. It also increases the dynamic lift at a given speed, and by enabling the boat hull to be more widely spread, increases the righting moment of the floats.

A side wind of 35 m.p.h. exerts a force of just under 120 tons upon the ship's side. If it is to maintain equilibrium in a side wind of this velocity, we shall require one of the boat hulls to push up with not less than 120 tons. Each float must, therefore, have a buoyancy of more than 120 tons and, at the same time, acquire an actual

weight of 120 tons. Accordingly, as the ship lands on the water, the ballast tanks in the hulls will be automatically filled with 120 tons of water by means of scoops, and as soon as they are full, it can be stopped. It will then float stably on the boat hulls



Here is a photo of the Burney dirigible, rising from the water's surface. The sluice gates have been opened, and before the motors are started, the ship is about to rise into the air. Speed of ascent can be controlled by the amount of water retained or spilled. These are the first photos ever to be published, the work having been shrouded in extreme secrecy.

MODERN MECHANICS

MAY
25¢

CONVENTIONS

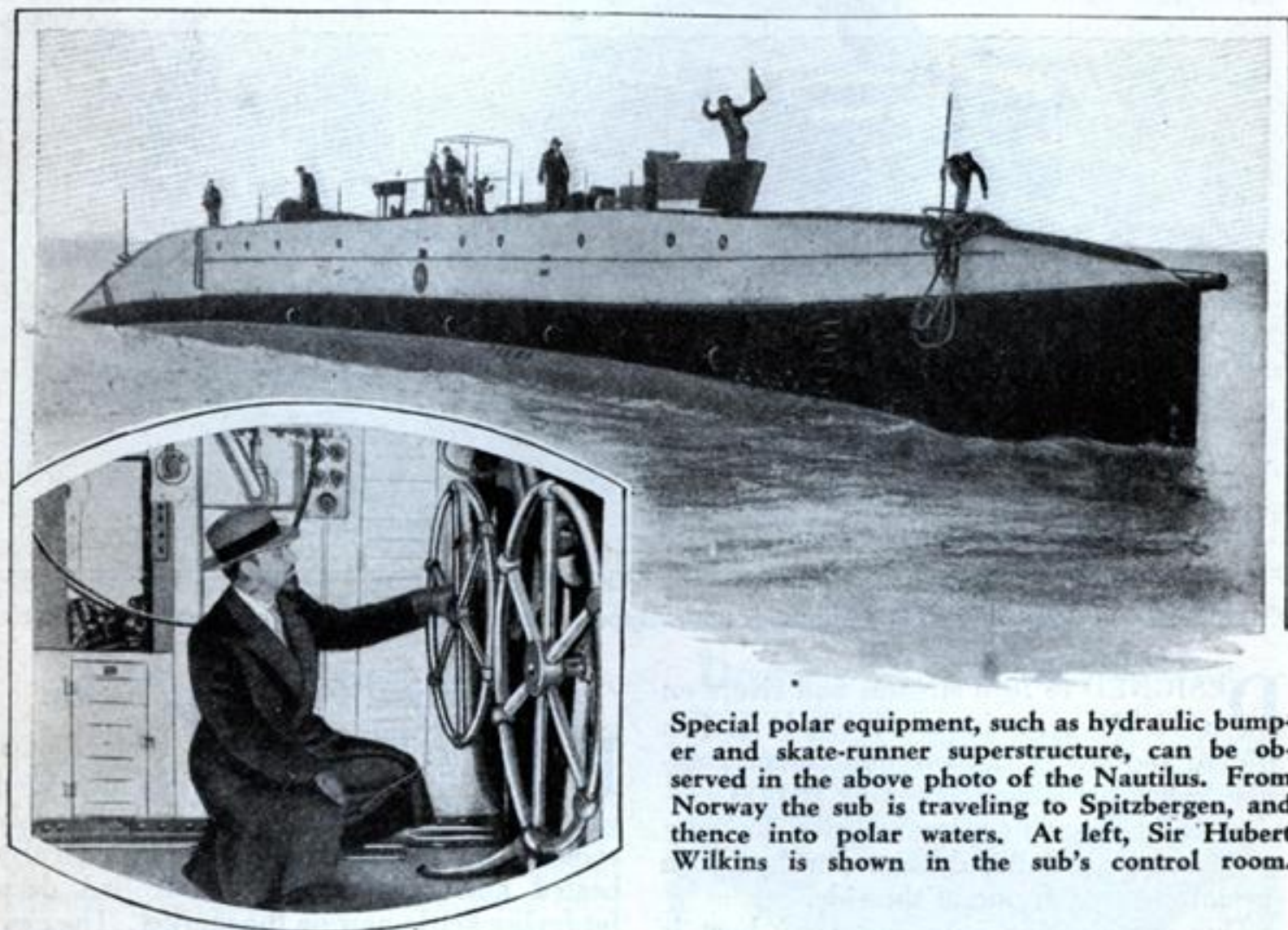


SEE PAGE 44.

MY NEW DIRIGIBLE on PONTOONS

by COMMANDER BURNEY of the R-101

DIVING Under Ice to



Special polar equipment, such as hydraulic bumper and skate-runner superstructure, can be observed in the above photo of the *Nautilus*. From Norway the sub is traveling to Spitzbergen, and thence into polar waters. At left, Sir Hubert Wilkins is shown in the sub's control room.

by LEW HOLT

Sir Hubert Wilkins' amazing journey under the North Pole in the submarine *Nautilus*, now under way, may discover evidence which will solve long-standing polar mysteries. Are there undiscovered islands near the pole—will the expedition discover a fathomless hole at the axis of the earth? Some of the riddles they will answer are described here.

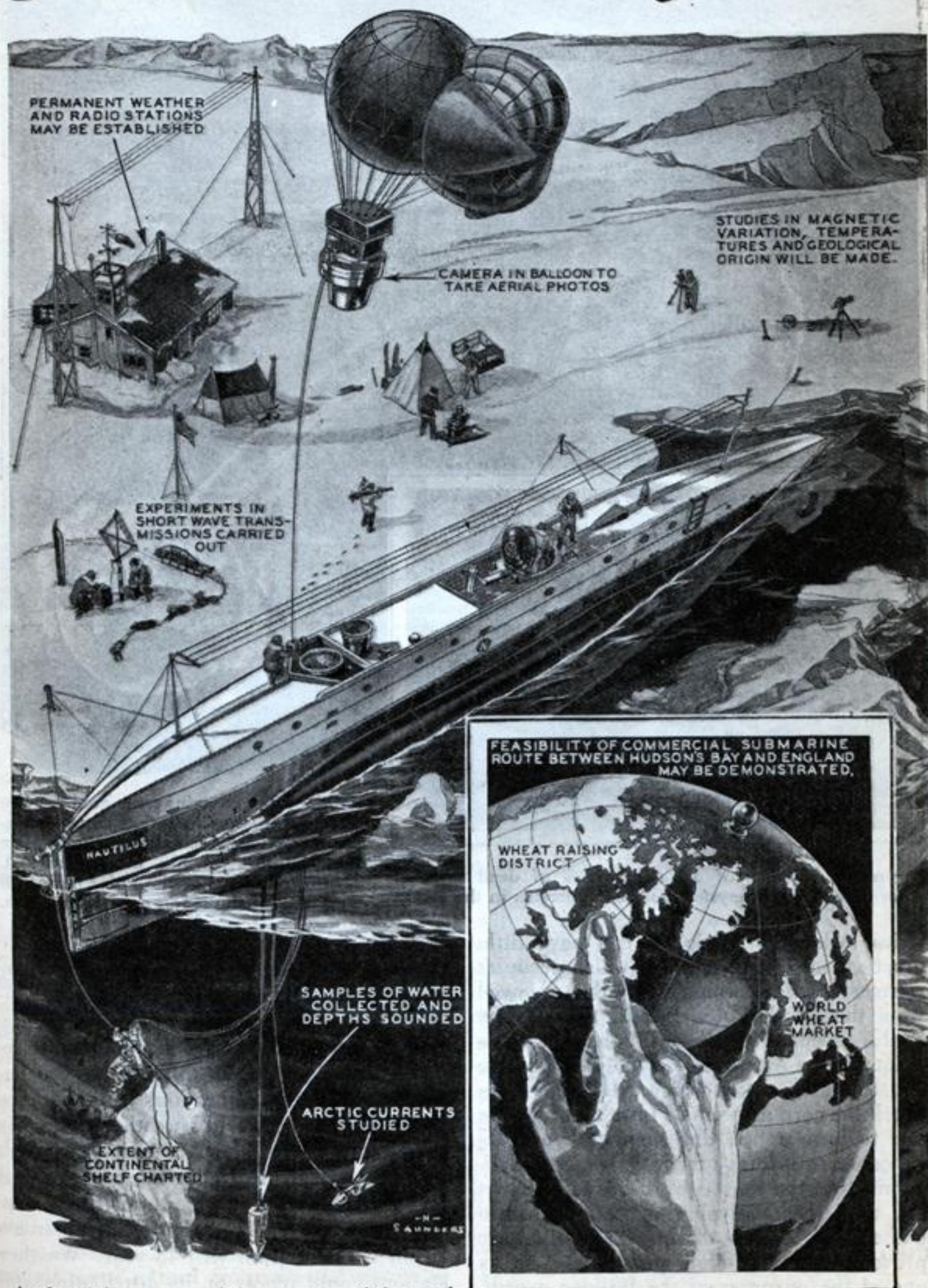
HOW deep is the Polar sea? What is the effect of Arctic ice on the world's weather? Can meteorologists, from a study of conditions at the North Pole, forecast months in advance droughts and hurricanes which will visit the rest of the world? Is there any basis of truth in the beliefs of some scientists that the Arctic basin represents a great hole in the earth left when the moon hurtled out of it ages ago? Will a submarine traveling through Arctic waters emerge gold-plated because of the supposed relatively heavy gold content of northern seas?

These are a few of the scores of scientific riddles which will be solved by Sir Hubert Wilkins and his crew of the amazing sub-

marine *Nautilus*, which is now traveling toward the Arctic, bent on the startling project of diving under the ice of the North Pole to settle once and for all questions which have puzzled scientists for years. If the mechanical safeguards installed on the *Nautilus*—described in last month's issue of *MODERN MECHANICS AND INVENTIONS*—are able to carry the submarine safely through the innumerable perils it will encounter on its daring journey through the top of the world, then this expedition, which many men have called foolhardy and doomed to certain destruction, will have justified itself adequately in the eyes of science.

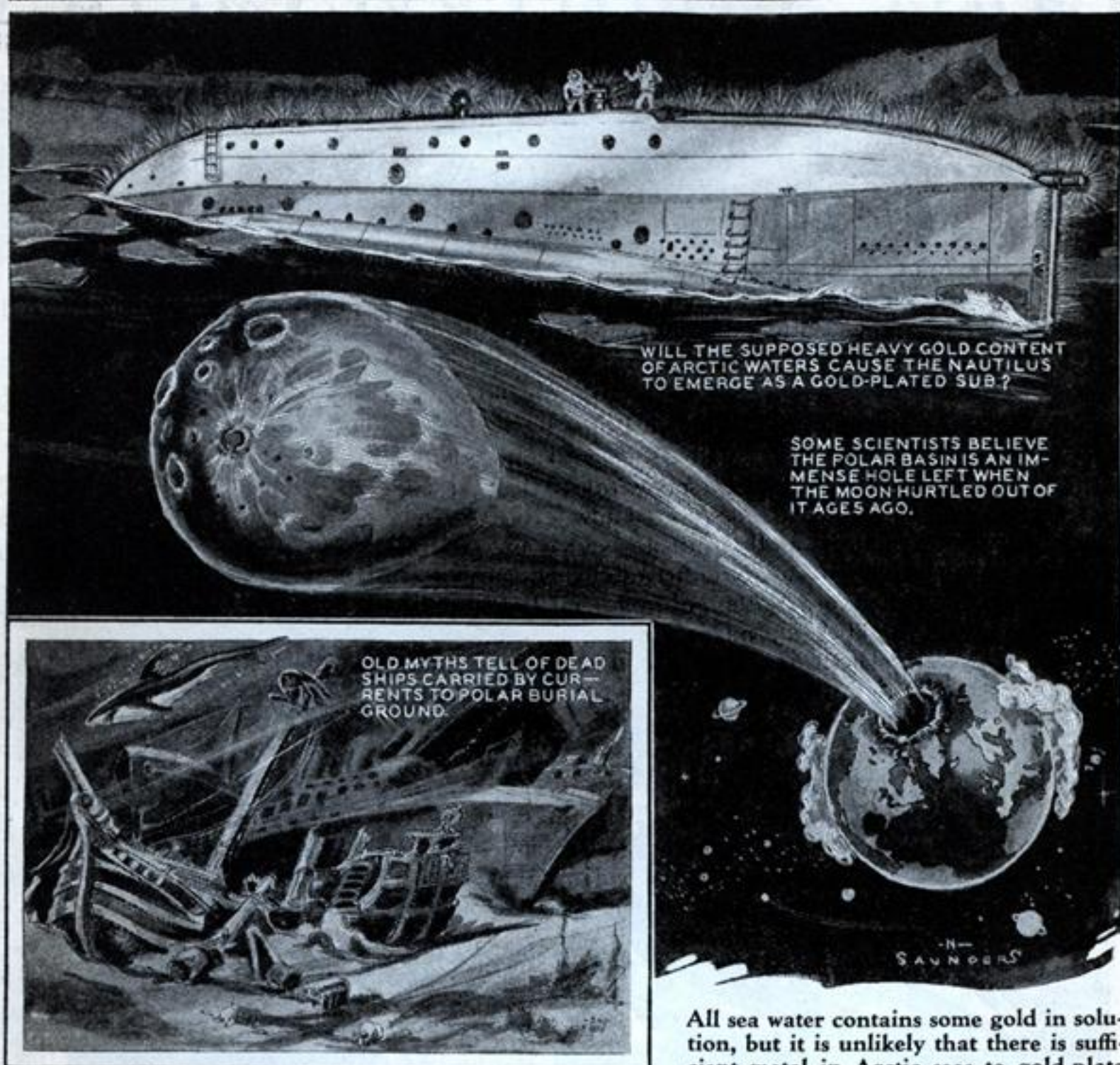
It may seem at first glance that the mys-

Solve Polar Mysteries



A pictorial summary of the purposes of the north pole submarine trip is presented in this comprehensive drawing. Picture of the globe shows how the shortest trade routes lie across the top of the world.

Myth and Legend Surround Polar Seas; Nautilus Will Settle Problems



Legendary accounts of a Sargasso Sea of dead ships in polar waters hint at mysterious ocean currents in the arctic.

teries locked in Arctic ice can have little practical interest to a world which occupies warmer lands thousands of miles removed from the North Pole. But if, through the establishment of weather stations at various points in the Arctic, meteorologists are able to gather information which will enable them to tell the corn growers of Iowa that they are due to have a hot, dry summer two years hence, or to inform orange growers of California that the season of 1935 will be wet and cold, then the value of the information gathered at the top of the world will have proved itself well-nigh priceless. That is one of the purposes of the Wilkins expedition. It hopes to find spots where permanent weather stations can be established.

All sea water contains some gold in solution, but it is unlikely that there is sufficient metal in Arctic seas to gold-plate the Nautilus, as has been predicted. Depth soundings of the Polar basin will determine if the moon once occupied it.

It has been calculated that 18,000 cubic miles of drift ice reach the Atlantic ocean yearly from Arctic regions. When you consider that all the people in the world can crowd into a space of one cubic mile, as illustrated elsewhere in this article, you begin to realize the tremendous volume of ice which affects the world's weather. There is even more ice in the Antarctic—so much that sea levels throughout the globe would be raised 30 feet if it were to melt in a day. The movement and distribution of polar ice is not uniform from year to year. Weather stations could report on its distribution and so supply information which, in connection with knowledge already at hand from tem-

NEW YORK BOMBED IN SHAM AIR WAR

FAWCETT'S

JULY 25c

MODERN MECHANICS AND INVENTIONS

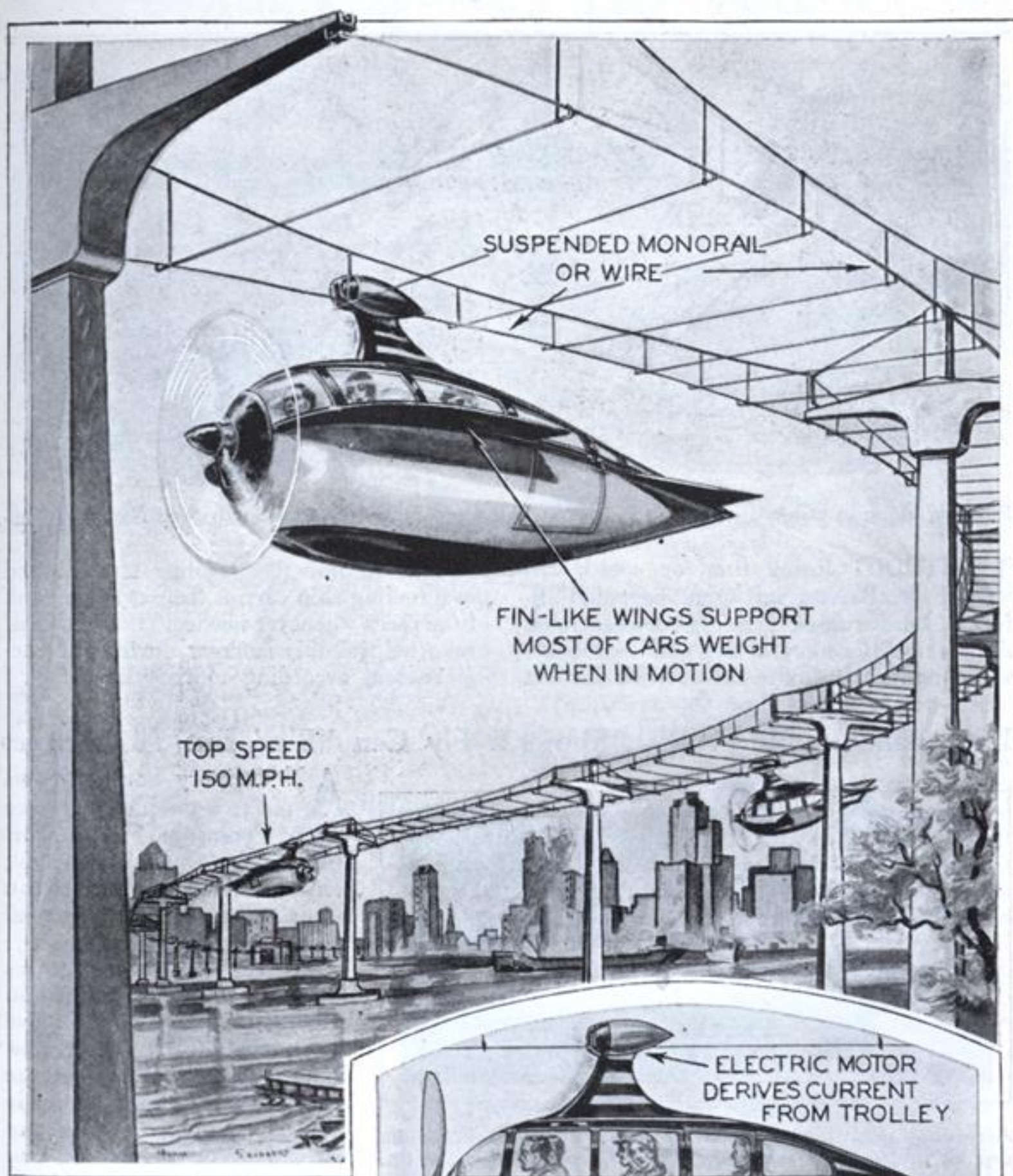


DIVING UNDER
ICE TO SOLVE
POLAR MYSTERIES

SEE PAGE 78

STEWART
ROUSE

Fast Electric Air Trolleys Planned by French Inventor



A UNIQUE air-trolley propelled over a monorail by an electric motor at a speed of 150 m.p.h. has been designed by Joseph Archer, a French engineer, who expects to demonstrate his unique invention in Paris shortly. The drawing above illustrates the essential features of Archer's design. The car is streamlined and

when in motion most of its weight is supported by fin-like wings projecting from its sides. By reversing the propeller passengers can bring the car to a stop within 100 yards.

Floating Airports of the Sea

Ocean stepping-stones in the form of floating seadromes bid fair to cut down the hazards of trans-Atlantic flights.

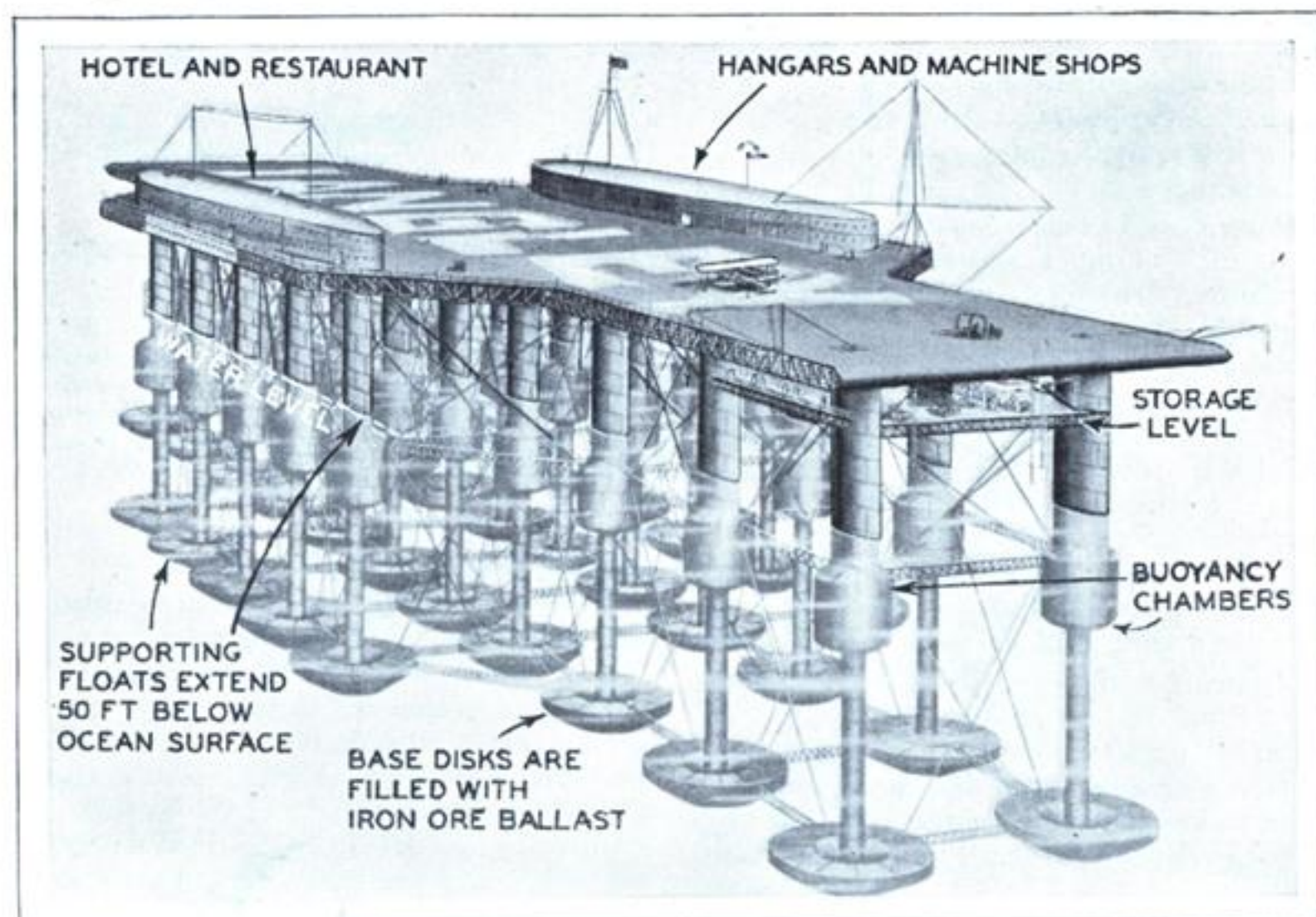
REGULAR airplane service across the Atlantic is brought a step nearer reality by the projection of plans for a series of floating landing fields which can be anchored at intervals of a thousand miles between America and Europe, affording a safe place for passenger carrying planes to come down for refueling and mechanical attention.

Three different types of floating airports have been designed. The one shown in the photograph below is the work of Edward H. Armstrong of Wilmington, Del. Stability of the airport, even in the roughest seas, is assured by the fact that the supporting floats extend for 50 feet beneath the ocean's surface, a depth at which the motion of the largest waves is not felt. The picture shows the method of arranging the buoyancy chambers and ballast tanks. Through a system of winches and drums

for paying out and dragging in the cables, the airdrome will move with the wind so that pilots can always land into the breeze.

A steel cable weighing 128,600 pounds will be used for anchoring the drome. The cable will taper from 2½ inches where it is attached to the drome, to 1½ inches where it touches the ocean floor. Engineering details are being worked out.

A second type of seadrome, varying from Mr. Armstrong's design in that it is constructed in units on shore and assembled at sea in any desired combinations, has recently been patented by Gustave M. Sachs, of Minneapolis, Minn. A drawing of his seadrome appears on page 75. Each unit will be 48 feet square. The platform will be supported by a series of cylindrical tanks, with the largest tank at the bottom filled with ballast to maintain stability. In assembling the landing field, the units are

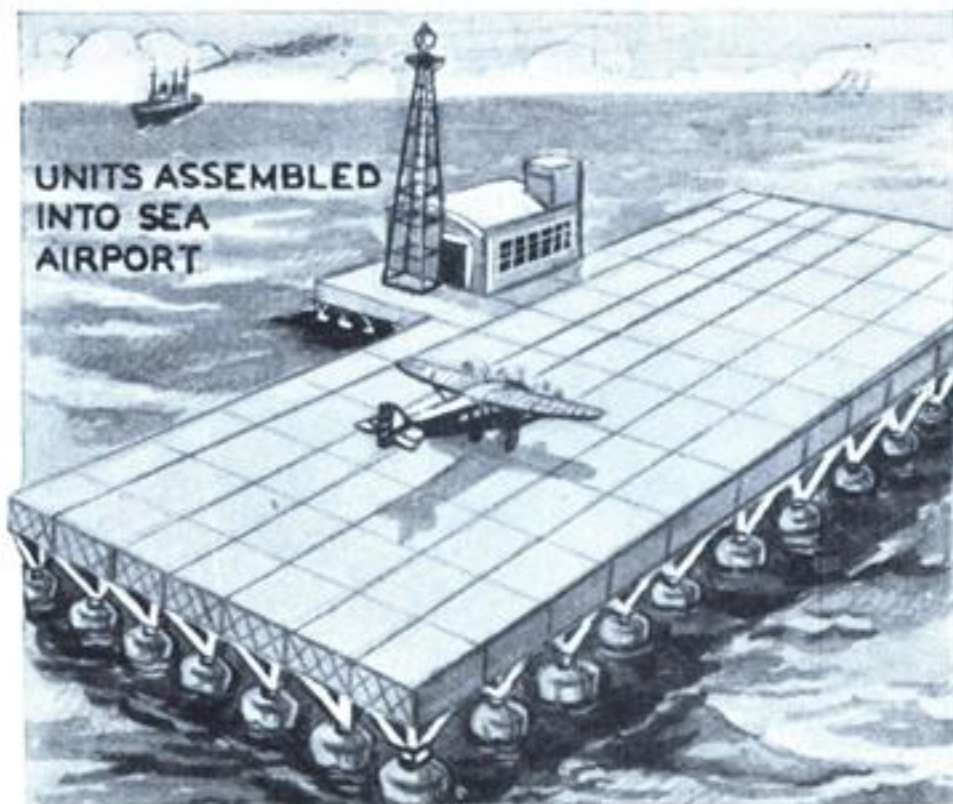


Seadromes of the type pictured above are soon to be built and anchored 400 miles apart on the ocean lane between Europe and the United States. These floating airports are expected to eliminate the dangers of non-stop sea flights by providing stopping-places for airplane refueling.

UNIT PLATFORM
48 FEET SQUARE



UNITS ASSEMBLED
INTO SEA
AIRPORT

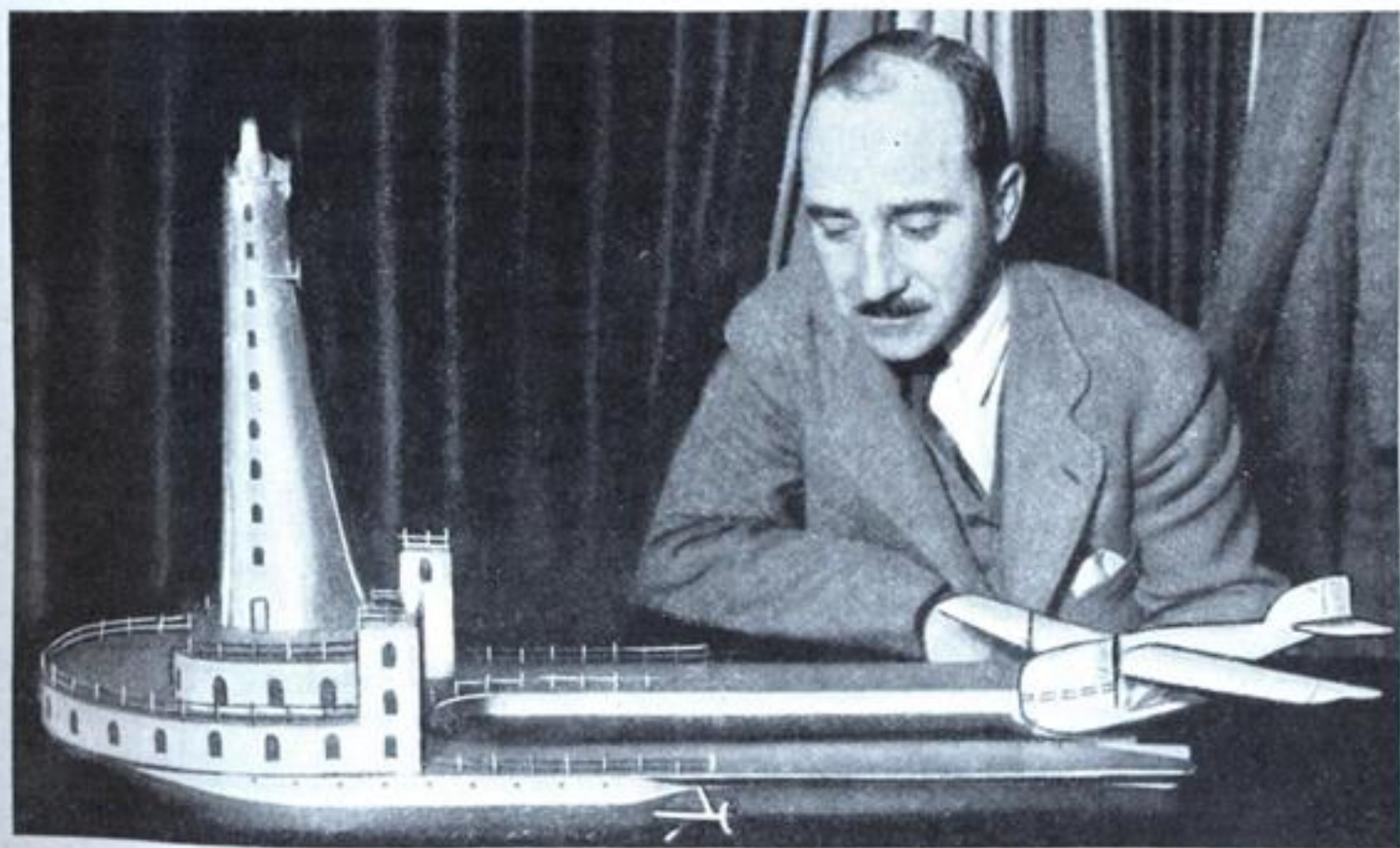


All the work of constructing the seadrome shown above, invented by Gustave M. Sachs of Minneapolis, Minn., can be carried out on shore. It is built of units 48 feet square which are carried out to sea on ships and then coupled together to form a landing field of any desired size. Ballast tanks and buoyancy chambers provide support for the platform even in the severest storms.

secured to one another by means of couplings and steel cables.

A third type of airport, pictured in the photo below, and also shown on the cover of this month's MODERN MECHANICS, is of

French design. It resembles a huge floating lighthouse, as the model shows, and is equipped with propellers and driving machinery to move it about as may be required.



This floating seadrome (see front cover), is of French design, and moves about by its own power.

MODERN MECHANICS

AUG.
25¢

AND INVENTIONS

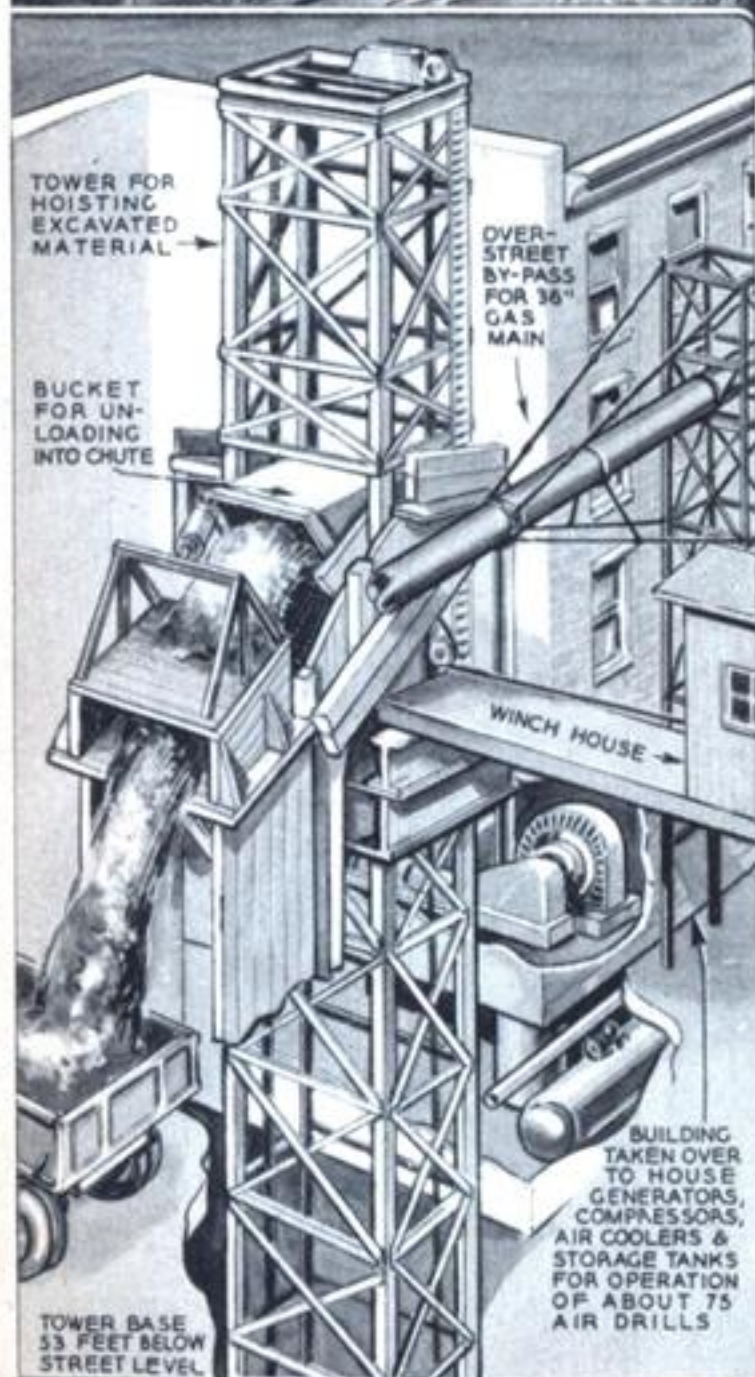
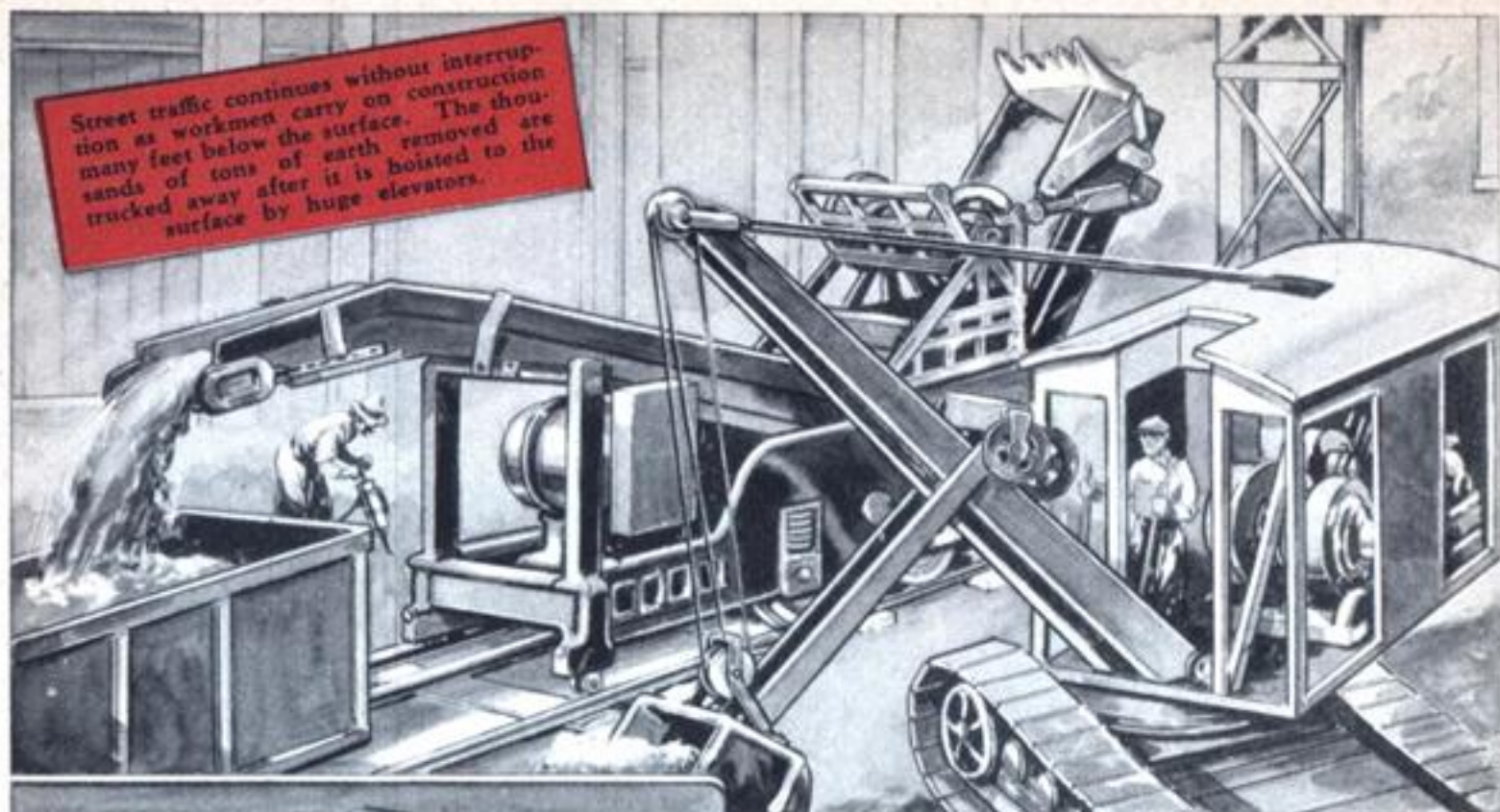


OCEAN AIRDROMES
SEE PAGE 75

UNDER *the* POLE *by* SUBMARINE

NORMAND

SAUNDERS



Street traffic goes on as usual while gigantic construction project approaches completion many feet below.

by

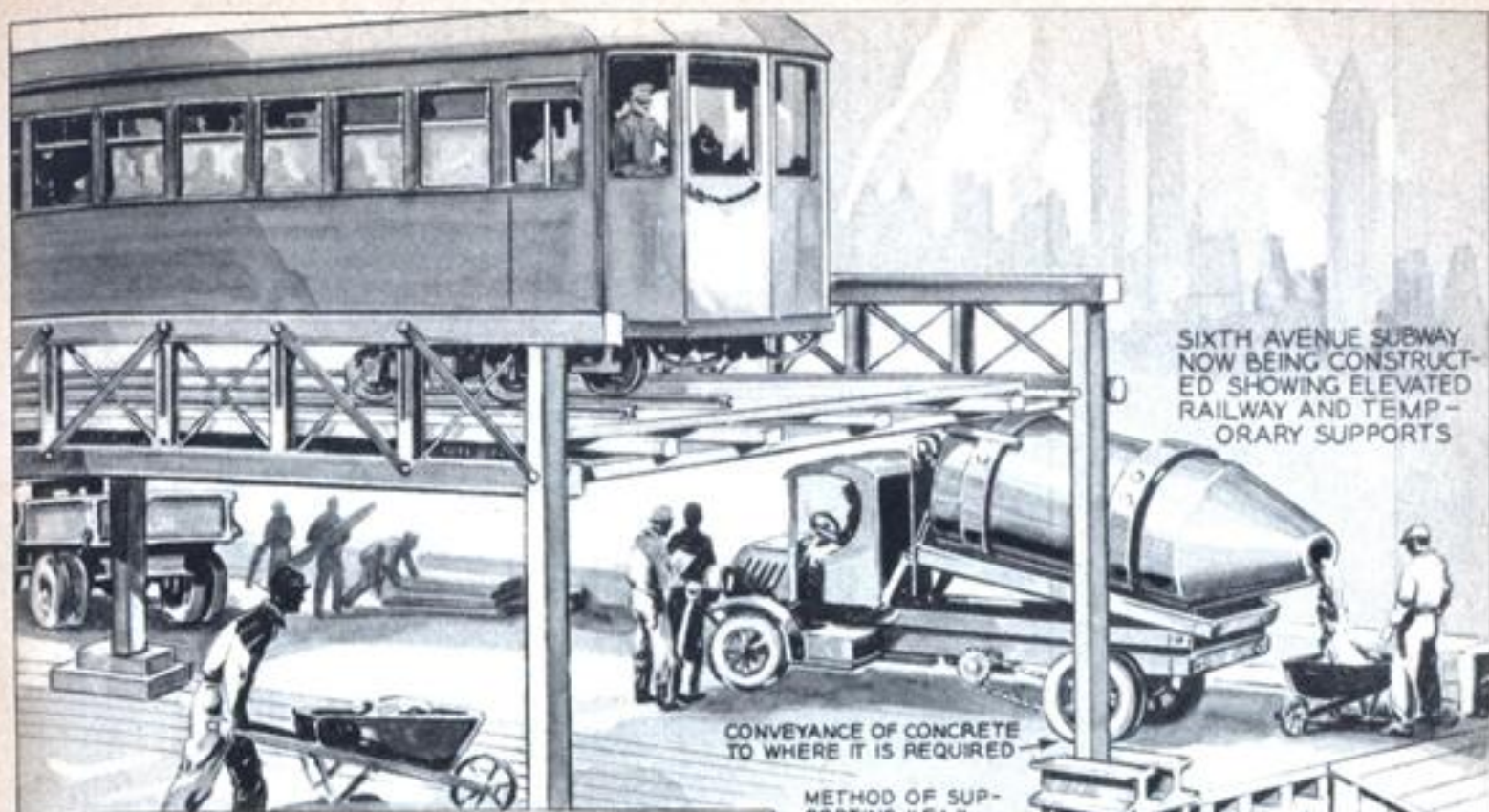
Don Glassman

UNDERGROUND flyers crashing through caves of darkness serve the largest metropolitan population in the world—New York. They carry people to and fro every minute of the year; storm, rain, snow or ice—nothing stops them. Under rivers, streets, skyscrapers, occasionally coming up for a breath of light and air, the trains for the most part run underground where the running is good and the tracks are clear.

Fancy running New York or London without subway traffic. It can't be done! So long as huge cities flourish, so long as we have street congestion, underground travel is the easiest solution to our problem. Experience proves it.

The world's greatest cities keep pace with

THE SUBWAY

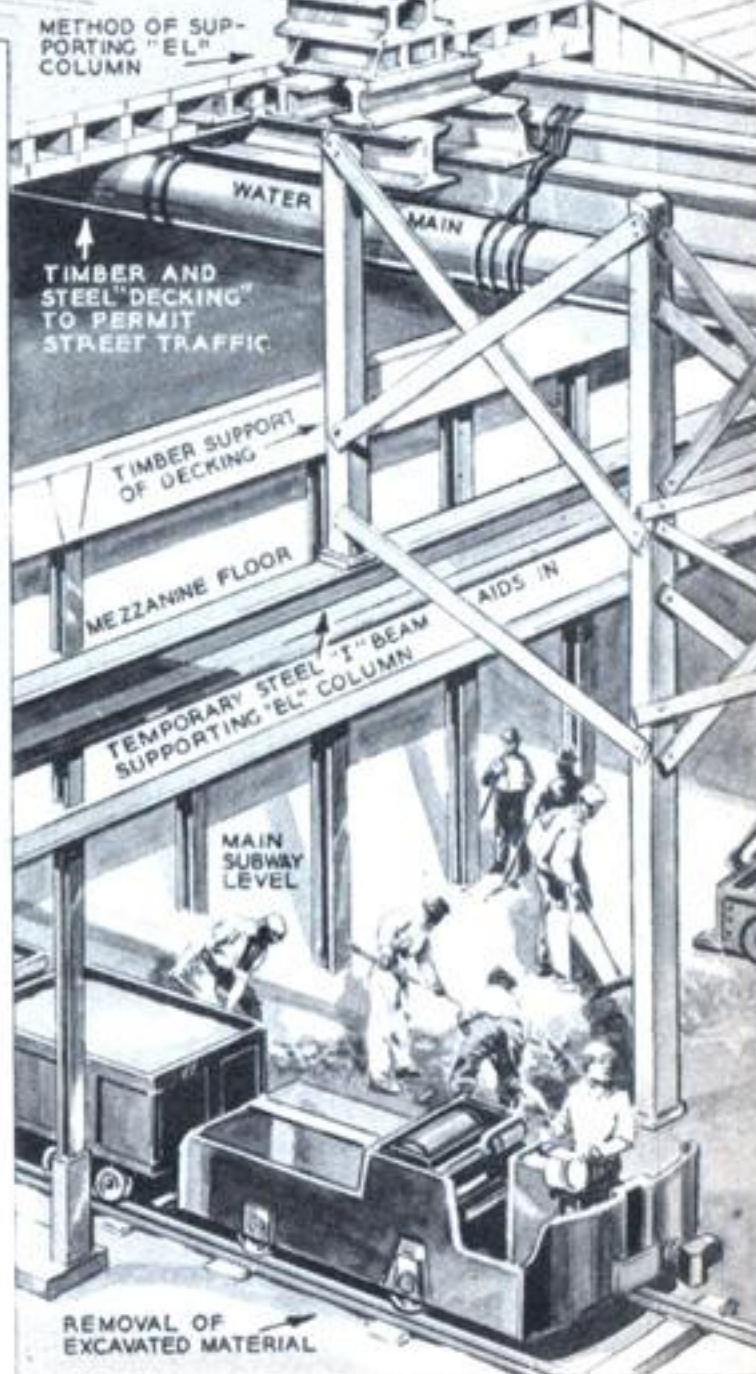


the growth of population and street traffic by constantly extending the routes of underground transit. Subway building began as a twentieth-century industry, and it seems destined to go on forever. Before one project is finished, another is under way. The process goes on and on, because people are insisting on motion without waste of time or effort. And speed is not a luxury any more.

The population spreading over the wide expanse of New York uses the most elaborate network of underground transit ever built. The city is distributed over something like 5,333 miles of streets, and about 848 miles of subway track are required to serve these thoroughfares with speedy subway transit.

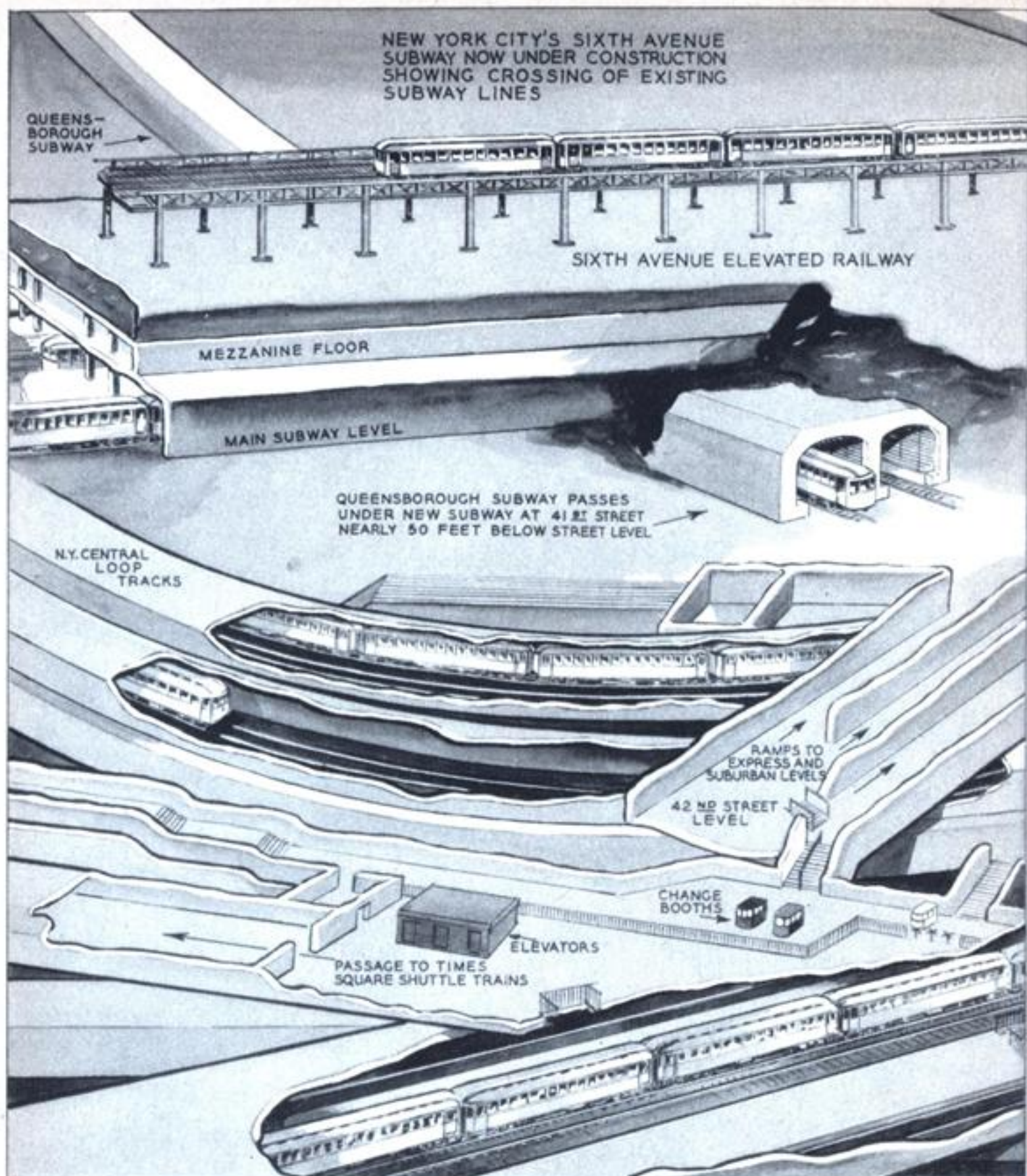
The newest link in a \$1,000,000,000 subway system is a two and one-quarter-mile stretch under one of the city's busiest thoroughfares—Sixth Avenue. The cost is \$57,000,000, more than \$25,000,000 per mile for a quadruple-lane subterranean highway, surely one of the most costly bits of rail construction on record.

Merely a brief examination of what engineers must contend with will give one an appreciation of why it takes so much money and five long years to build so short a subway section.



CITY GROWS

July, 1937



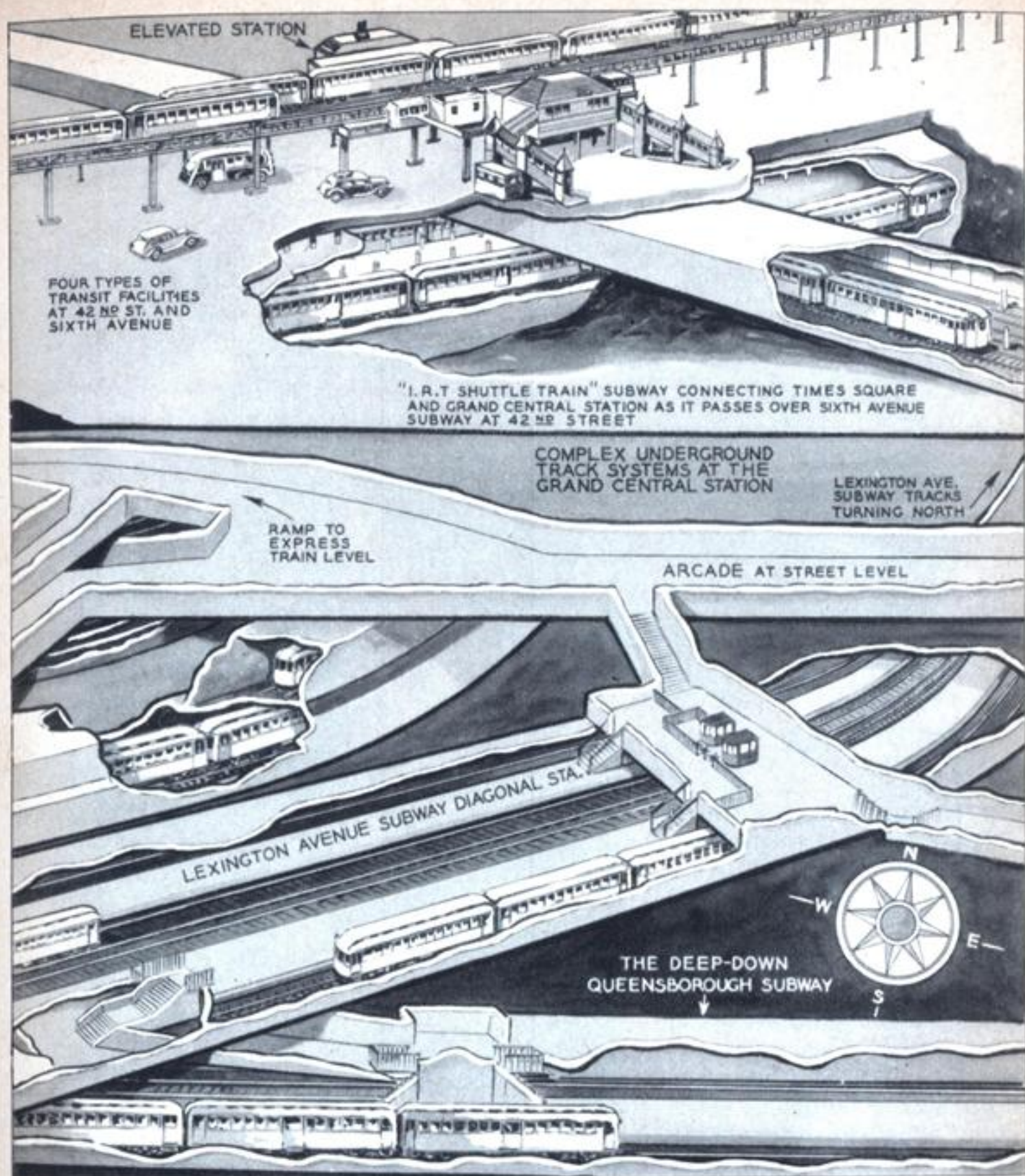
An artist's drawing of the intricate network of subway arteries below the busy streets of New York City. The Sixth Avenue Elevated line continues its operation and business goes on as usual during the period of subway construction many feet below.

In the first place, the overhead street traffic must go on day and night as if there were no construction below. Heavy busses, trucks and other surface vehicles travel the roadway constantly. Also, the same street supports

the pillars of an elevated train structure on which passenger trains are always running.

For twenty-four blocks of the distance, the new subway route runs above the tunnels of a high-speed interurban train. Under one

Newest link costs more than \$25,000,000 per mile as public continues demand for more and more travel aids.



Shuttle train connecting Grand Central with Times Square will pass over Sixth Avenue subway at 42nd Street. Queensborough Subway operates at a depth considerably below Lexington Avenue line. Above both is complicated track system at Grand Central.

street intersection, it must leap over the Pennsylvania Railroad tunnels, dive under another subway and a tunnel, and support the elevated structure over the street.

To all this difficulty is added the presence

of a seventeen-foot aqueduct from the Catskill Mountains, carrying a stream of clear water for the city's daily use. Gas mains, steam pipes, electric conduits, sewers, cables, sub-basements, and underground freshets

Subway travel gives public one of its biggest nickel's worth in form of a 26-mile trip under city streets.

The THREE DECK CITY



HARVEY WILEY CORBETT

A typical metropolitan three-level business district as planned by Harvey Wiley Corbett, famous New York architect quoted in this article.

THE three-deck street is coming. Our sons and daughters living in the great cities of tomorrow will have become accustomed to three levels. If they go to the heart of the city on rail they will be on one level. If they take their motors they will speed along on a street level designed exclusively for wheeled vehicles, and if they seek to walk about the heart of the metropolis then they will confine themselves to the foot level.

The Regional Committee of New York City has considered such a plan for the relief of congestion. Noted architects have drawn plans to show how such a city would look. Harvey Wiley Corbett is probably the most outspoken in its favor.

"First," he says, "divide traffic into the three natural divisions into which we long ago began its segregation—rail, wheel, and foot.

"Since we have already put much of our rail traffic underground in our large cities, let us elevate the sidewalk to the existing second story level and leave the street level wholly to wheel traffic,

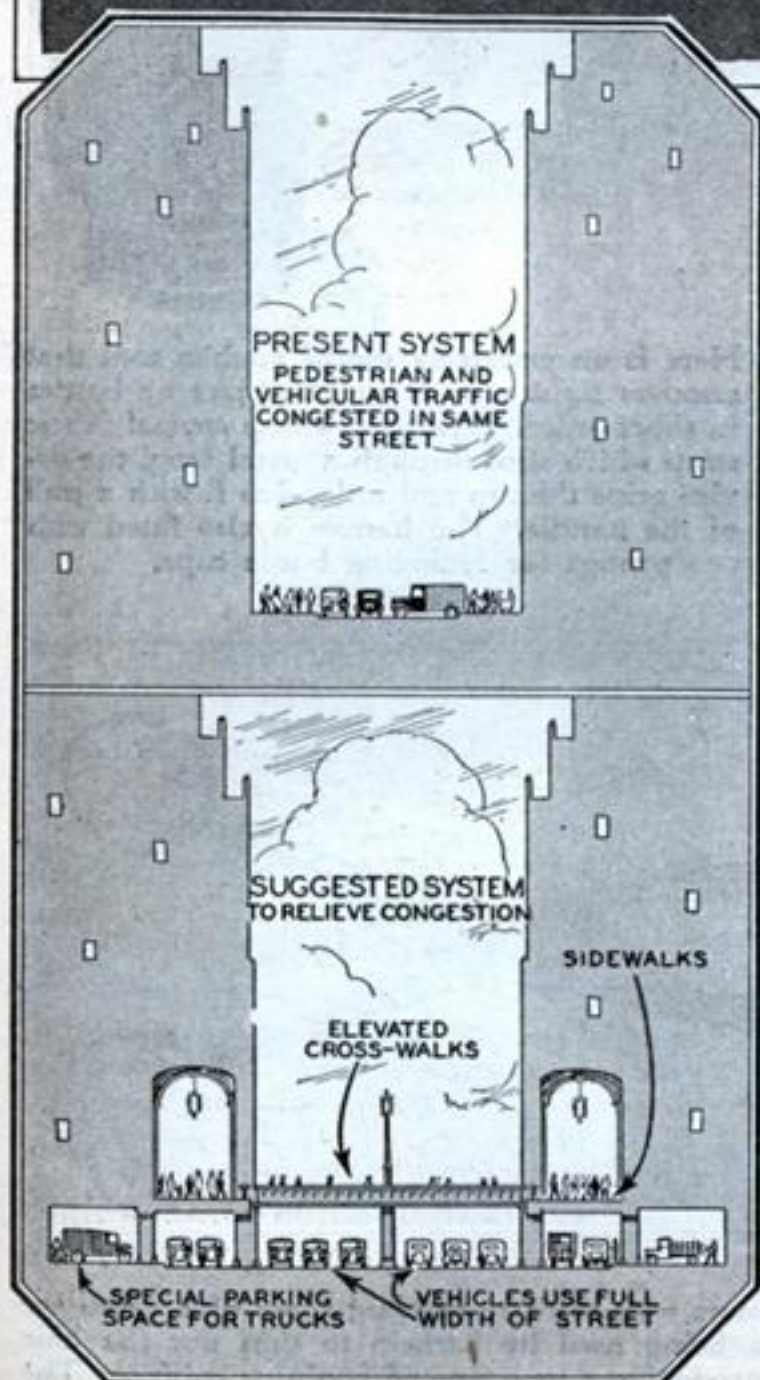
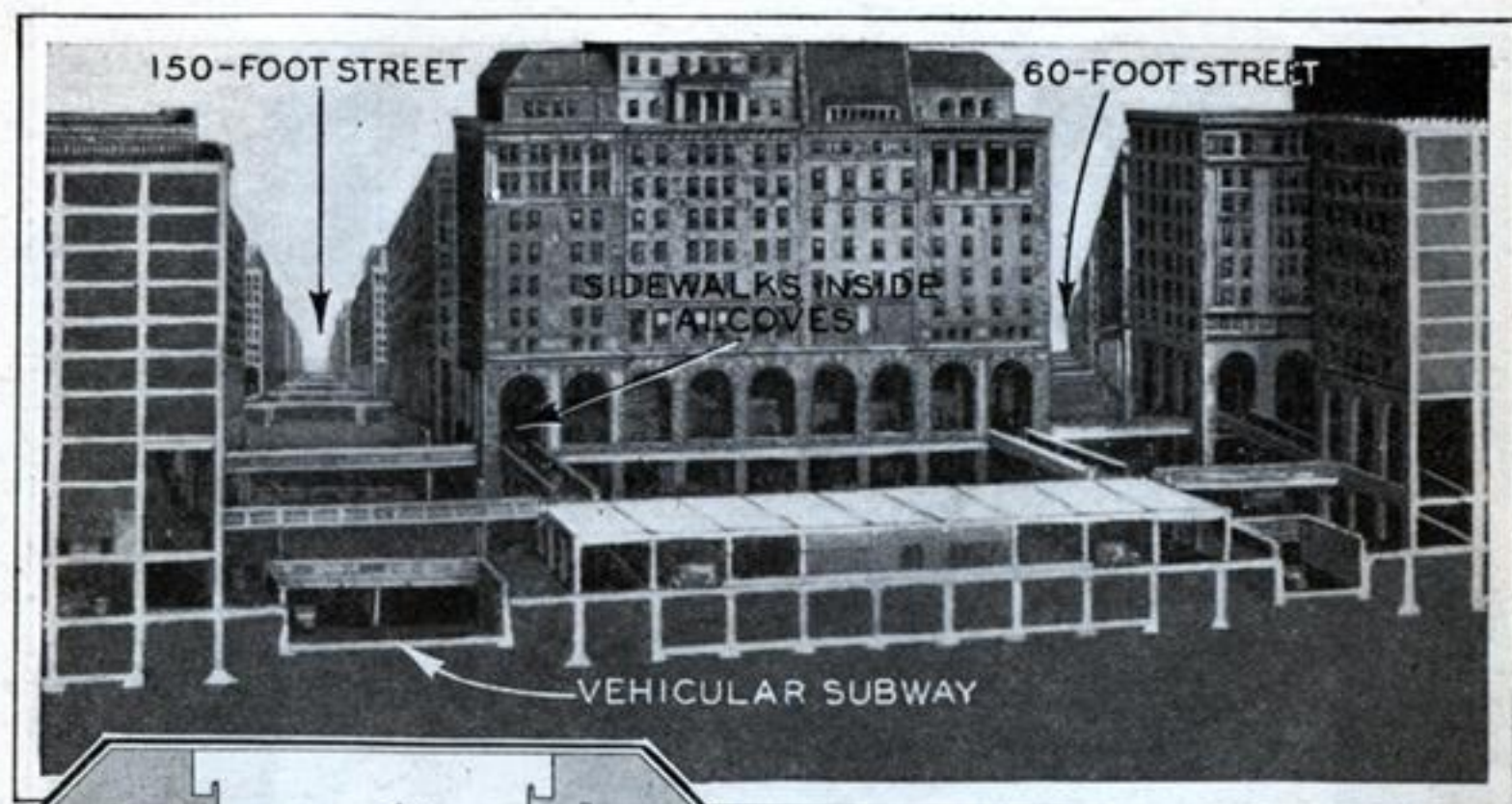


Traffic lights will not be needed in cities of the future, for intersecting traffic will run beneath the main arteries and pedestrians will pass overhead.

"The sidewalk would then be carried on a strut a few feet away from the building line, cantilevering under the building to carry the load, and being supported so as to permit steps up or down.

"This would increase the capacity of any thoroughfare, say two hundred per cent even when we did not have the third level for rail-traffic underground. Our present sidewalk

is COMING *by* UTHAI VINCENT WILCOX



These two drawings compare the present and future traffic systems, and show how little change is needed to relieve congestion under this plan.

Vehicular subways for express traffic and loading and parking space under the building line are indicated in the above drawing of a future city.

system is archaic. It originated in a day when none could have foretold the throngs which now stop at street intersections to wait the passing of automobiles or dodge their way through and between them.

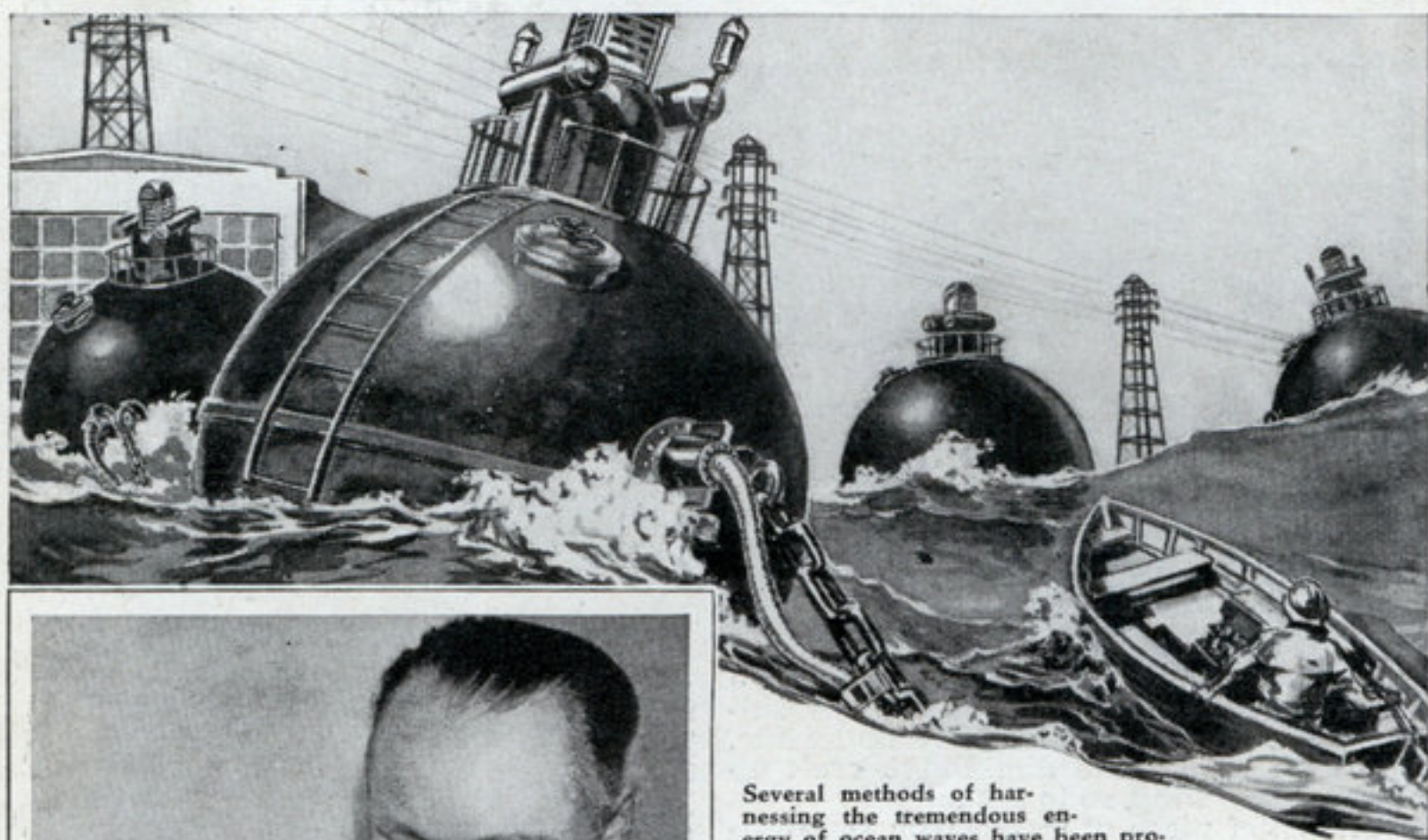
"Under this arrangement streets would be bridged at the sidewalk level and foot traffic never become mixed with wheel traffic. Shops and stores and entrances to buildings would be placed at the level of the elevated sidewalk. This leaves wheel traffic where it already is, on the surface of the earth. Thus its level doesn't have to be dug out or built up."

The triple deck street, architects say, has the obvious advantage of elasticity. The plan can be tried out with small units at a time and at a minimum of expense. There is no need of cutting new streets and the great expense of burrowing and excavating is eliminated.

"The greatest advantage in the three level street," Mr. Corbett says, "lies in its ability to permit the uninterrupted development of each kind of street traffic."

Health authorities point out that light and air would be better on the elevated sidewalk level. There wouldn't be so much carbon monoxide. Retail concerns would attract shoppers who wouldn't fear traffic dangers.

Putting Nature's Power



Several methods of harnessing the tremendous energy of ocean waves have been proposed. At the left is shown Erich Roeder with a model of his motor, comprised of a circular base with an upright pillar in its center, to which are connected levers operating a generator. Six hemispherical floats, moved up and down by waves, are expected to drive the generator.

Upward of 40,000 inventions a year are granted patents by Uncle Sam, but not one of these offers a practical solution of the problem which scientists agree is the most pressing of them all—that is, how to harness natural sources of energy for power. Mr. Cole does not profess to have solved the problem, but the methods he describes here point out the trend of probable development.

WHAT is the most needed invention? Not television—not new kinds of airplanes—not speedier automobiles. Men of science are agreed that what the world needs most is a motor which converts the sun's rays and other forms of natural energy into usable power. Orville Wright, Lee De Forest, Elihu Thomson, and other leading scientists are among those who proclaim the need for a new motor.

There are two sources of inexhaustible energy which at once occur to the inventor—wave or tidal power; and solar rays. A Los Angeles inventor has developed a wave motor—an "inertia" motor, he calls it—

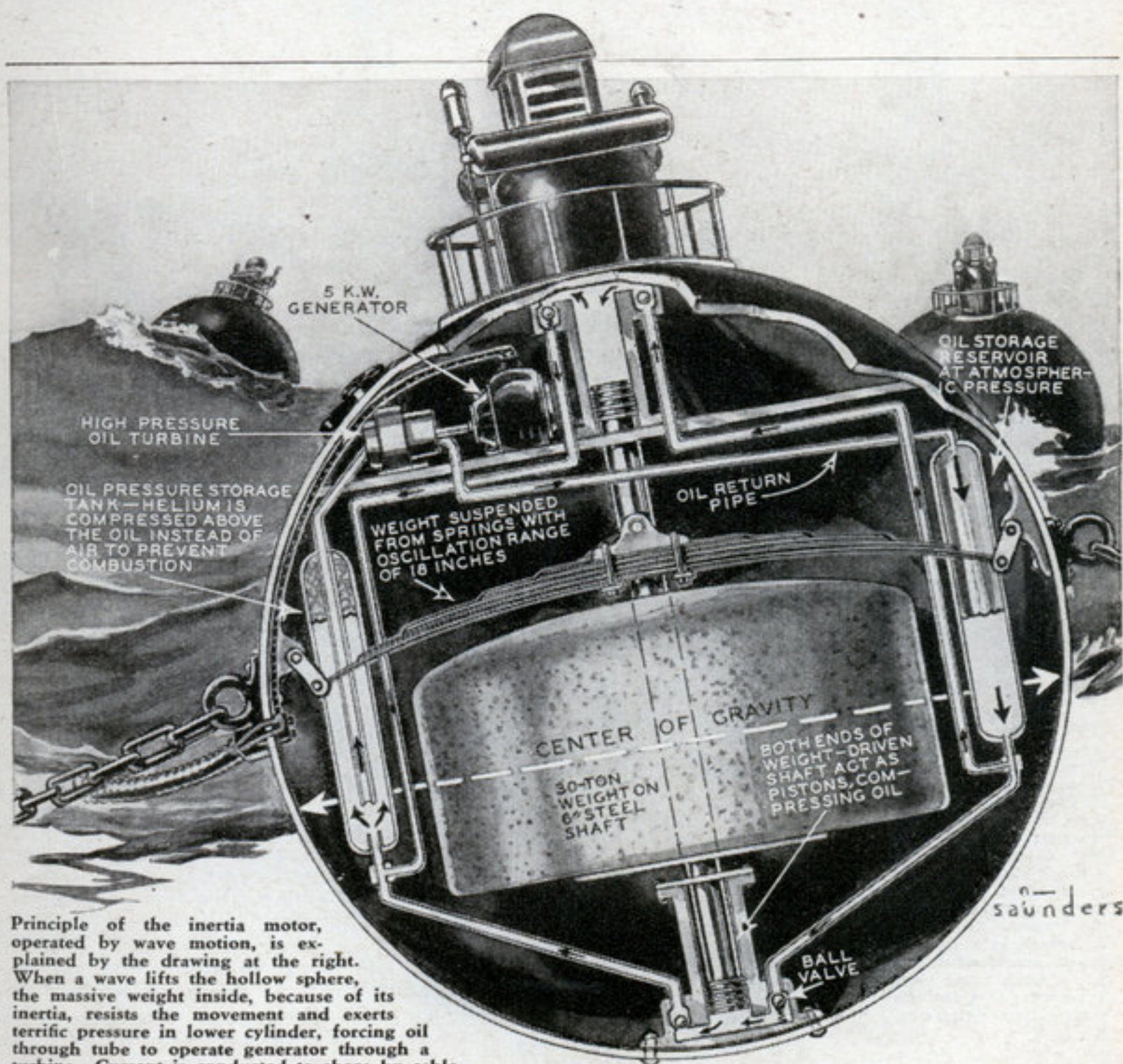
which gives promise of being developed into a practical commercial project.

Scores of so-called "wave motors" have been built in the past, but none has proved a conspicuous success commercially. Usually the initial erection cost and the maintenance cost has been out of proportion to the results obtained. And, too, the force of a storm has been underestimated, and the first severe gale completely wrecks the machine.

The new "inertia motor" is absolutely storm-proof—in fact it could outlive a tidal wave. And, too, it is the acme of simplicity—it requires no foundation, and has no

to WORK

Methods of Harnessing
Natural Energy Described
by DICK COLE



Principle of the inertia motor, operated by wave motion, is explained by the drawing at the right. When a wave lifts the hollow sphere, the massive weight inside, because of its inertia, resists the movement and exerts terrific pressure in lower cylinder, forcing oil through tube to operate generator through a turbine. Current is conducted to shore by cable.

connection with the ocean bottom except by its anchor chains.

A study of the accompanying diagrams makes it clear how the inertia motor operates. If you are mechanically minded, you will be impressed. The application of the name "inertia" will be obvious. When a wave starts to lift the hollow sphere, the massive weight inside, *because of its inertia*, resists the movement and exerts terrific pressure in the lower cylinder. Finally the inertia of the weight is overcome. Then it possesses momentum. When the sphere reaches the crest of a wave, the combined effort of the momentum and the recoil of the huge, semi-elliptic springs exerts an equal pressure in the upper cylinder. The tremendous pressure is applied to oil, which, in turn, operates a special turbine which runs a generator. The current

is conducted to the shore by submarine cable.

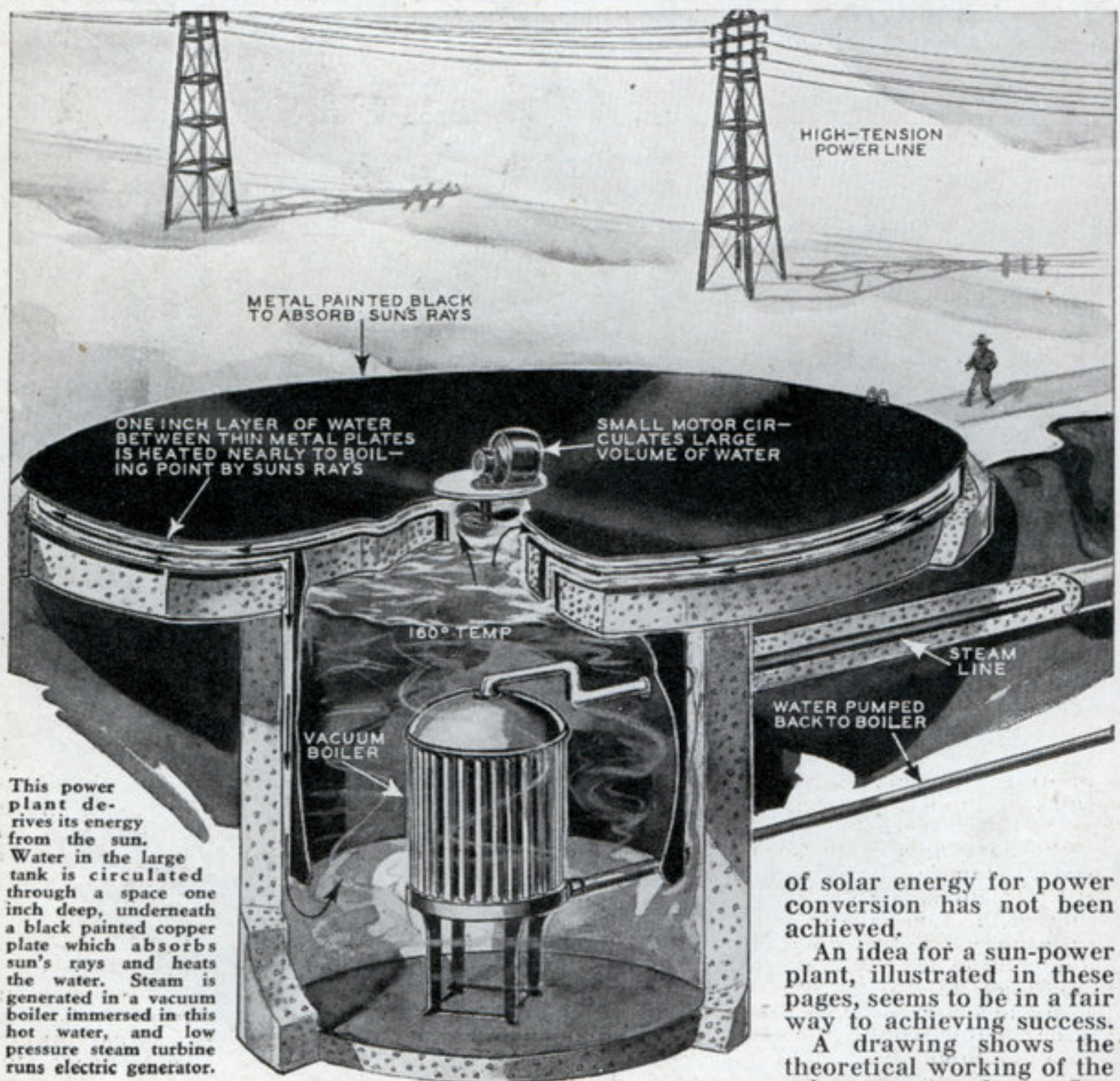
The idea seems wholly practical. It is readily conceivable that a battery of "inertia motors" could be built into an elongated float set parallel with the wave movement, and power in unlimited quantities would be available.

The cost of building these motors would not be excessive—the maintenance cost is almost nil—the storm hazard is eliminated. Collision is the greatest hazard, but this is hardly worth considering as the float would have "running lights" at night.

A conservative estimate of the cost of the complete installation, except batteries, indicates that the value of the current generated, at 5c K.W. hour, would equal the installation cost in 18 months.

The power available from ocean waves

Inch Layer of Water Heated by Sun Generates Steam in Vacuum Boiler



of solar energy for power conversion has not been achieved.

An idea for a sun-power plant, illustrated in these pages, seems to be in a fair way to achieving success.

A drawing shows the theoretical working of the solar power plant. One side of the unit is a tank

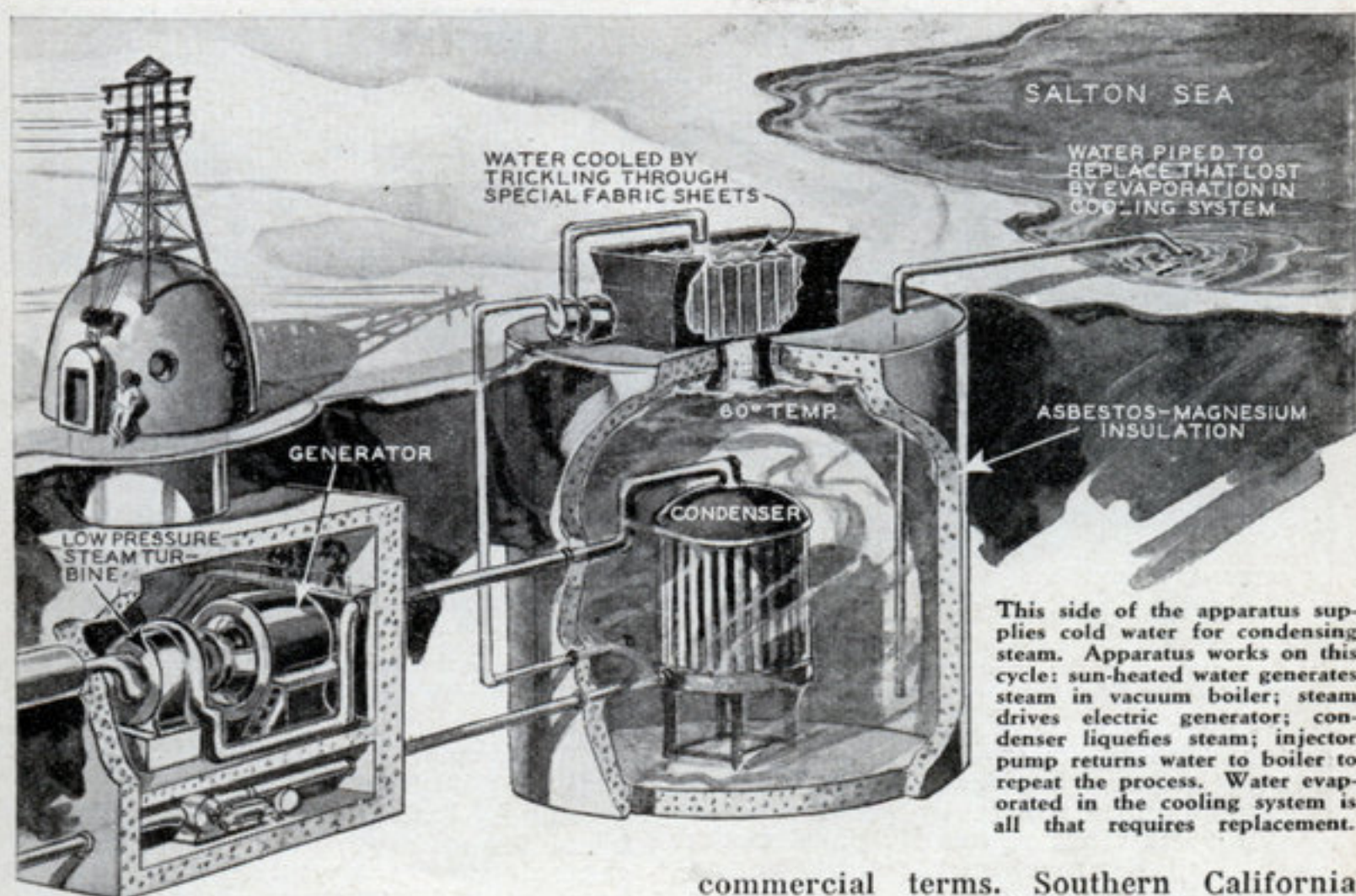
is unbelievably huge. Suppose a wave comes along and lifts a 25,000-ton ocean liner 10 feet in 5 seconds. How much power is expended? The 25,000 tons is equivalent to 50,000,000 pounds, which, raised 10 feet, represents 500,000,000 foot pounds. Since this work is performed in 5 seconds, the amount done in one minute would be six billion foot pounds. One horsepower is that required to perform 33,000 foot pounds per minute, so simple division gives the wave's horsepower as 181,818!

Every day in the year the sun is dissipating incalculable, immeasurable energy upon this earth of ours, energy which can be brought directly under control for immediate use, instead of waiting for a new geological era to make it available. The trapping and utilization of solar energy is not new—"solar engines" have been built before—but direct, commercial application

containing water, heat insulated on all sides. On top of the tank is a shallow basin of greater area than the cross-section of the tank itself. This basin is covered with a layer of sheet copper providing a space of about one inch within the basin. Water from the tank enters the basin at the center point and spreads out to the rim where it is returned to the tank.

The top of the copper covering is painted flat black. Obviously when this tank is exposed to the glaring sun, the black surface absorbs the heat which is communicated to the water in the shallow basin. The entire mass of water is sealed from the atmosphere, and evaporation, which would tend to cool the water, is prevented. The thin layer of water becomes very hot and is carried into the main tank. The circulation goes on and on, constantly building up the temperature in the main tank. The heat in-

Tests With Models Have Proved Principle of Operation to be Sound



sulation prevents radiation losses. In a working model, the temperature was built up to 180 degrees.

We have now established a mass of hot water. Now for the cold element. The tank at the right is the same volume and is insulated the same as the "hot" tank. In this case the water is circulated to an evaporation cooling system. This consists of a shallow upper tank from which are suspended many sheets of a special flax fabric such as desert water bags are made of. The water trickles down these. This cooling system will maintain the temperature of about 60 degrees in the cooling tank.

Apparatus Runs Automatically

We now have established a heat differential of nearly 100 degrees. The boiler and the condenser are an innovation. Note that each is set in the water of their respective tanks. The system is synonymous with placing a conventional boiler in a mass of molten lava. The boiler-condenser system is partly filled with pure, distilled water. The initial vacuum is established by injecting live, super-heated steam into the system. Then the cocks are closed, and when the steam condenses a permanent vacuum is established. Thereafter the boiler vaporizes a vast amount of water; the condenser liquefies the vapor; an injector pump returns the water to the boiler; an eternal cycle going on continuously, while between the two, a low pressure steam turbine converts the energy into terms of kilowatts.

Let us now transpose our theory into

commercial terms. Southern California offers some ideal locations for a solar power-plant. Almost any point along its coast would meet the physical requirements, but Salton Sea, at the north end of Imperial Valley, is most ideal. Here the mid-day sun gives rise to temperatures of 110 to 120 degrees. And, too, the air is very dry which adds to the efficiency of the cooling system.

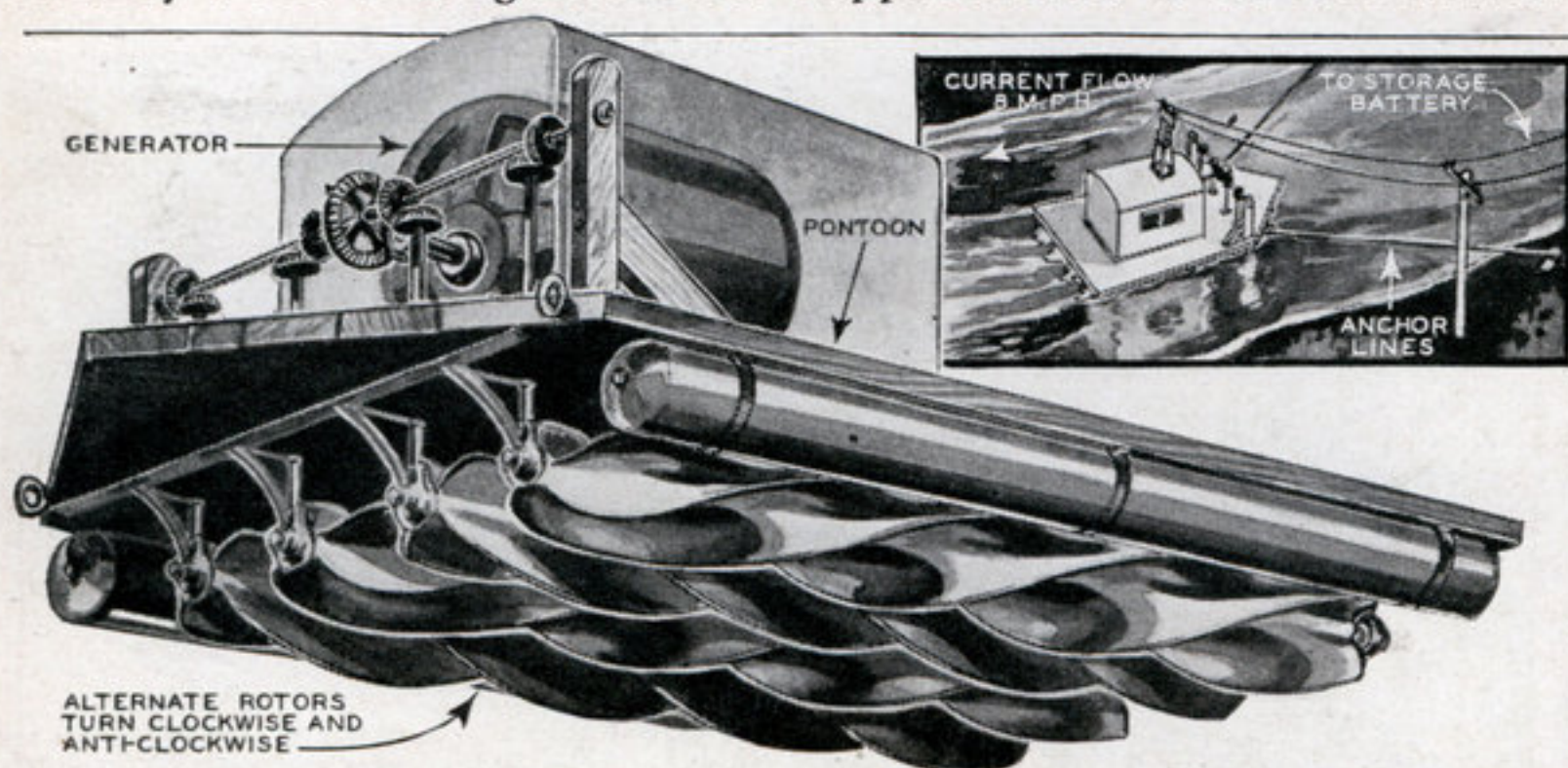
Construction Cost Moderate

The initial cost of erecting a power-plant like this would not be prohibitive. Even if it cost twice as much as a conventional steam plant of the same power output, this would be more than offset in several years by lower upkeep cost. The solar plant could be made so automatic in operation that it would require practically no attention.

Practically the only upkeep cost of this solar distillation plant is for fuel for a small gasoline motor which operates two pumps; one for pumping the distilled water to the storage tank, and the other for maintaining the salt water in the evaporation basin. A surplus of water must be provided to the evaporation basin to prevent crystallization, and, too, the basin must be thoroughly flushed out occasionally.

Still a third apparatus, deriving its power from running water rather than wave motion, has been built by an Arizona rancher. A main irrigation canal bordered his land, with a flow of 8 m.p.h. He constructed a raft with four 18-inch spiral rotors underneath, linked the driveshaft of each to a common shaft which drove a 32-volt gen-

Flow of Water in Irrigation Ditch Supplies Ranch With Free Current



An Arizona ranch owner generates all the current used on his ranch from the 8 m.p.h. flow of an irrigation stream. Movement of the water turns the rotors which drive an electric generator. Principle of the design is exceedingly simple.

erator. The motor functions with perfect satisfaction and supplies all the current consumed on the ranch. One of the accompanying drawings makes its construction clear. A similar machine can easily be constructed by anyone.

Electricity From Flowing Water

A momentum motor of this type has infinite possibilities. Imagine one with a battery of 20 spiral rotors 30 feet in diameter set in "the narrows" of the Bay of Fundy with its 60-ft. tides! Or in the St. Lawrence River or at Sault Ste. Marie! Or at numerous points in the Ohio, Missouri, Mississippi or Colorado Rivers! A momentum motor set in the Golden Gate at San Francisco without in any way impeding navigation, would develop enough power from the inflowing and outflowing tides to supply electricity to all the bay cities. As long as the tides ebb and flow, our supply of electricity will be assured.

On all sides we see examples of wasted energy—power! Think of what is wasted every day by the millions of automobiles and other moving vehicles. In an automobile, heat, the very essence of power, is wilfully wasted in enormous quantities—in the radiator and out through the exhaust pipes.

Waste Power of Automobiles

Suppose a coil of copper tubing were placed inside the exhaust manifold, and a highly volatile liquid, as ether or alcohol, were injected into this coil, wouldn't the expanded vapor run a fairly sizeable "steam" engine? And couldn't the vapor be condensed in a special radiator and be used over and over?

What about the energy wasted when the brakes are applied—dissipated in friction? Cruising along at 30 m.p.h.—"Stop" sign—

on with the brakes. Twenty to fifty horsepower gone beyond recall.

Suppose instead of friction brakes, electrical brakes were used, and the current generated were stored in batteries, how much wasted energy could be saved?

Of course, with fuel at a reasonable price, it is not practical to make the elaborate installations necessary for conserving the wasted energy. We have one outstanding example of its being done. On the electrical section of the Chicago, Milwaukee & St. Paul railroad, when a train goes down the long grade over the Cascade mountains, the motors are converted into generators and serve as electric brakes, and at the same time push considerable current back into the line, which is utilized by another train coming up the grade. Trains are scheduled to take advantage of the electrical counterbalance.

Heat Represents Power

Heat is usually associated with all motors and engines. Somewhere in the scheme of things heat has played a part. But the generally accepted idea is that abnormal heat is required, as in the steam engine and internal combustion motor. The fact of the matter is that potential power exists wherever two masses of different temperature are available. Dr. Georges Claude demonstrated this with his remarkable vacuum, or low pressure steam turbine, down on the coast of Cuba, described in a past issue of *MODERN MECHANICS AND INVENTIONS*.

Much has been written about atomic power, the tremendous energies compacted within the atom being depicted as capable of furnishing all the power the world will ever need for billions of years. This is undoubtedly true, but scientists are by no means sanguine that a method of applying the atom's power will ever be devised.

MECHANIX ILLUSTRATED

APRIL

15^c



See page 66

**Exclusive—
GENERAL MOTORS' REAR ENGINE CAR!**



Harvey Earl, GM's style chief, poses with his rear-engine Corsair.

General Motors' Rear-Engine Car

WHENEVER the subject of rear-engine cars plays across the auto columns of the nation's newspapers, a certain bunch of boys in Detroit snicker to themselves!

Rear-engine cars! Not for the American public, they say. And they ought to know. They're the head stylists and engineers for General Motors Corporation. Why are they so convinced?

They know this rear-engine stuff isn't new at all. In 1902, 18 out of the 23 automobiles in production had their engines placed aft. But then gradually the engineers were overcome with violent symptoms of *front-engine fever*. They wanted to put the motors up front! And they said they had good reasons for doing so.

Safety was one of these reasons and better weight distribution another. They got their way eventually and soon almost all

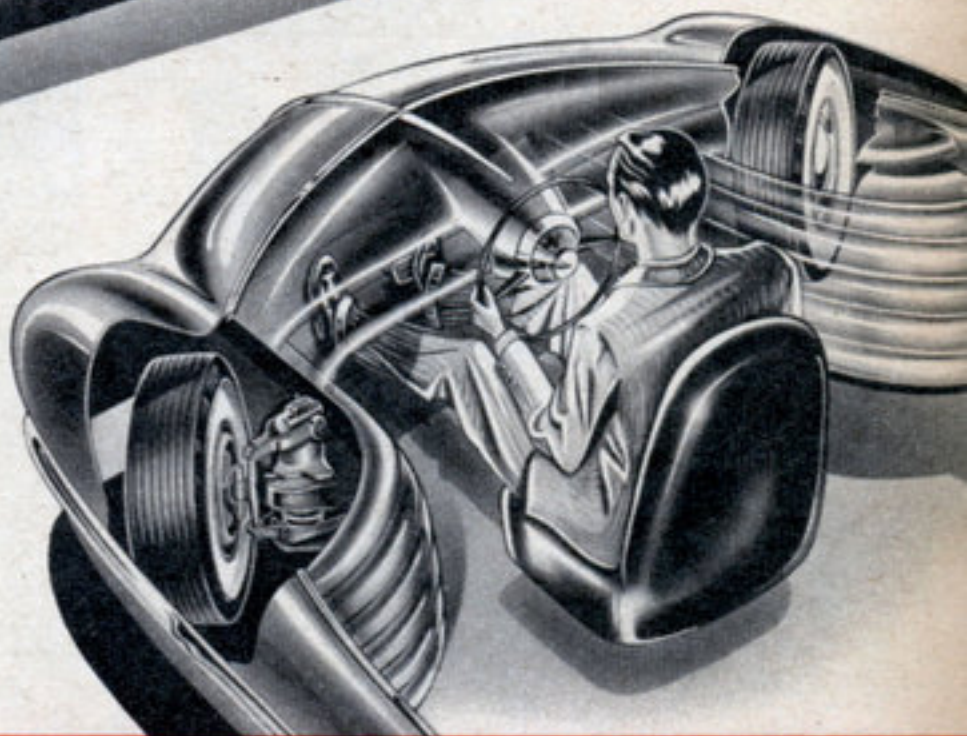
By Bernard W. Crandell

American cars were being manufactured with engines in the front. But then the picture started to reverse itself. In 1925, the Julian chugged into print with "the first rear-engine car in 20 years." Entirely unsatisfactory and "old-fashioned," it shortly thereafter became the first rear-engine model to go off the market in 20 years, too.

In 1931, Sir Dennistoun Burney, noted airship designer, had a go at a rear-engine car. He tried to peddle it to GM and Studebaker on the theory that its 66-33 weight distribution (66% of the weight on the back wheels and 33% on the front) would, when the breaks were applied, shift to a 50-50 balance. He also thought his machine took the bumps easier with front-wheel shocks rotating in an arc from the rear axle, and bumps under the back wheels being absorbed by a rotation around the front axle.



The sleek Corsair, shown above and on MI's cover, was built to test the merits of moving the modern auto's motor from the front to the spot usually occupied by the baggage compartment. The cutaway drawing at the right shows the big drawback in this revolutionary design—the narrow seat up front. Turning space for the wheels allows room for only driver.



MI reveals the exclusive story behind the mysterious stern-powered GM auto—and tells why you can't buy one today.

If this sounds screwy, it's typical of some of the inspired double-talk that has been going on ever since the revival of the rear-engine ruckus.

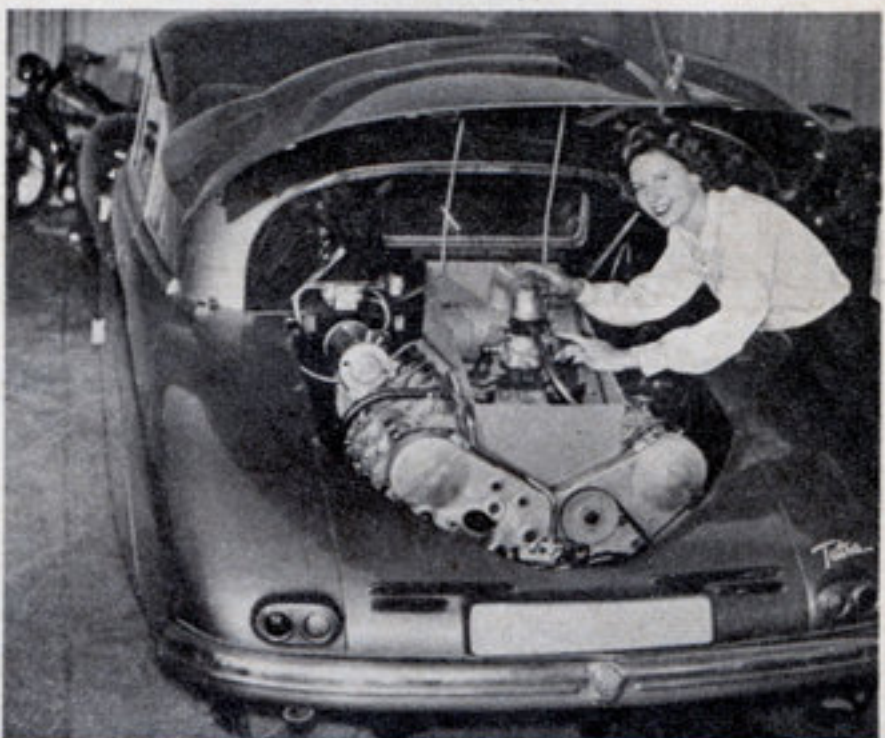
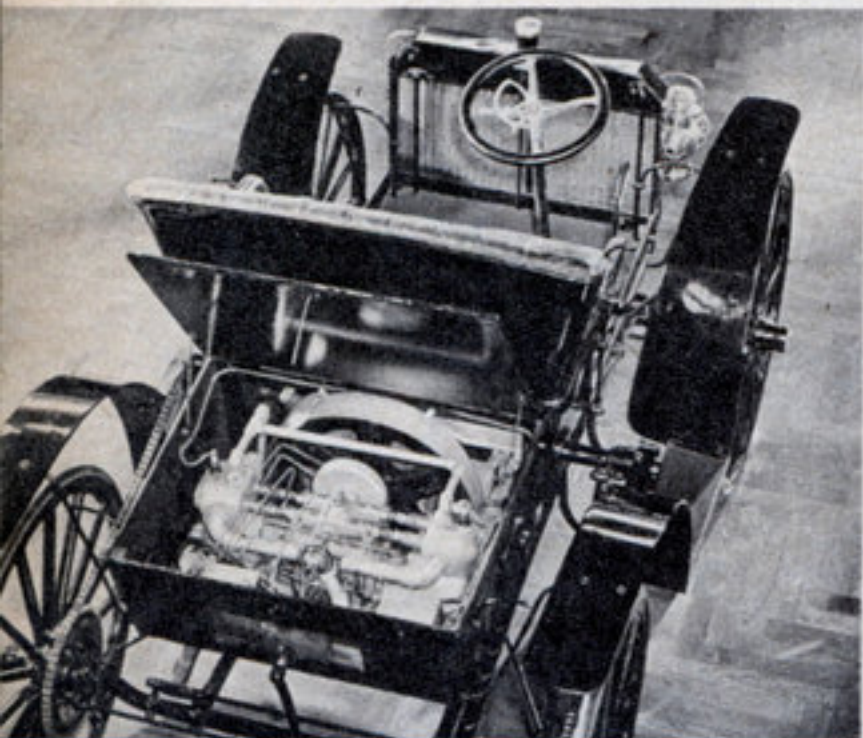
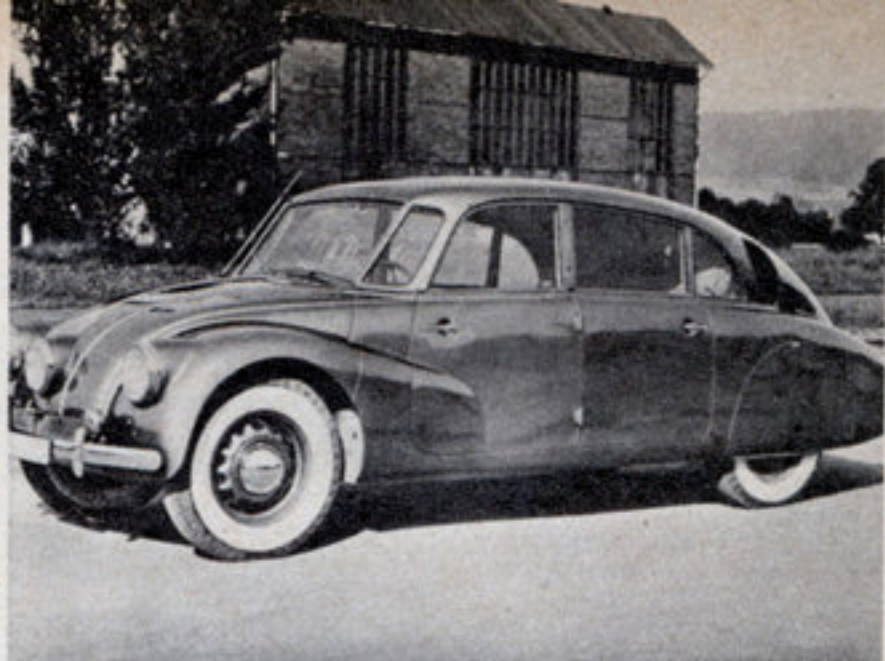
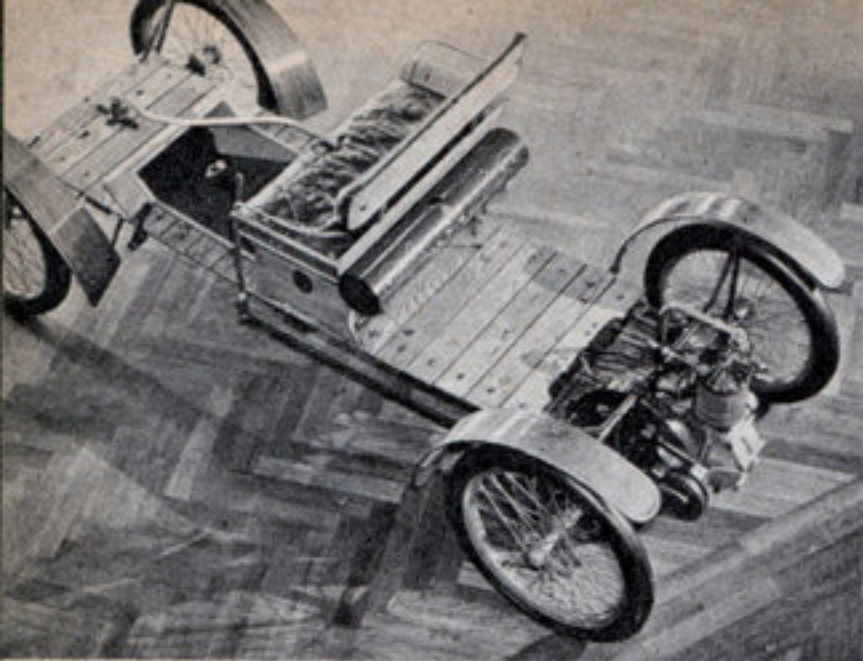
The Burney design, which went wholehog on radiators with one in back to cool the engine and another in front to heat passengers, was sold eventually to the British Crosley. They came out with a \$3000 sedan which set no sales records.

An experimental rear-engine design made its appearance in 1933. John Tjaarda, a Detroit who designed two experimental models for the Briggs Manufacturing Company, claimed it was ridiculously simple to drive. He explained in the magazine *Automobile Topics*: "When starting, all one has to do is turn on the ignition, when a red light will show on the dash. Then step on the throttle which simultaneously starts the engine and the red light will go out and

a green light shows. As the engine can not be heard in the front seat, the lights will tell what is happening in the rear."

Tjaarda's cars caused a mild sensation in the industry for a year or two. Then Chrysler and Ford, potential customers for whom Briggs already made bodies, had to decide whether the sensation was good or bad. The freaks had V-8 engines mounted over the rear axles and buzzed through the streets of Detroit without mishap until winter arrived. The original notion was that the engine heat could not seep forward and cause discomfort during hot weather. As it turned out, passengers were cool enough in summer, but during the winter they froze. No heating system had been devised!

Most unconventional and probably most comfortable of all interiors in a rear-engine experiment was brought out several years before World War II by William B. (Bill)



The Orient Buckboard, that racy number at the top of the page, was one of the first cars to feature rear-engine drive—back in 1903. The 1909 Schacht, above, had an opposed-type motor like the Tucker.

The Czech Tatra, top, has three headlights out in front but no engine under that stubby hood. The smiling young lady shows where the Tatra's 75-hp V-type motor rides in the rear—as in our buses.

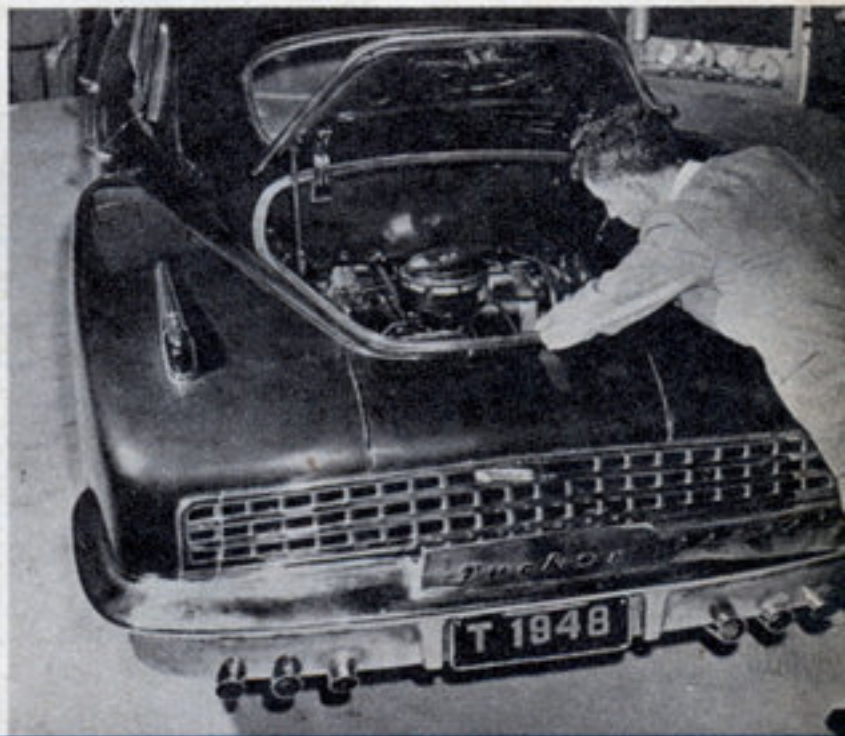
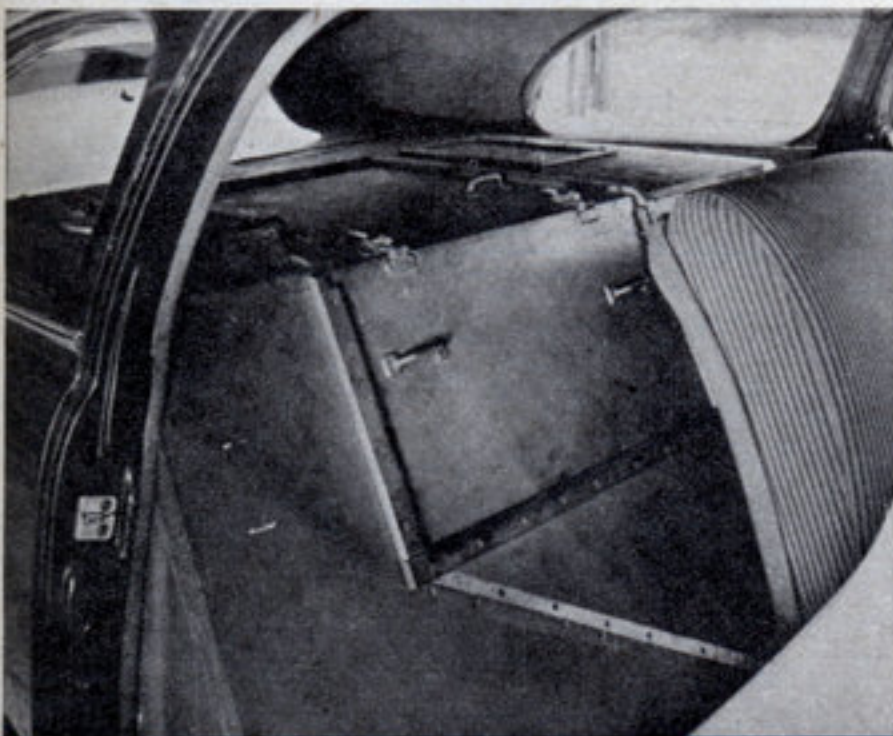
Stout. He first achieved engineering fame by building the first all-metal airplane. In 1934, Stout showed up with a living-room on wheels. There were broad back seats, three chairs which could be moved around and a comfortable chair for the driver. A drop-down bed and a table completed the ensemble. Stout planned to build 100 of these cars the following year. Instead of launching production, however, he refined the job into a newer model called the Scarab. It got a good press but never got any farther down a production line. One reason alone was enough to kill the idea—it would have had to sell for \$5000.

In 1938, Emile E. C. Mathis, French motor manufacturer, and Axel Wenner-Gren, Swedish industrialist, announced plans to build in France, Sweden, England and the U. S. a small car with a radial engine in the rear. It would be "designed to give 50 to 60 miles on a gallon of gasoline." In this coun-

try they hoped to sell the car for \$500 but the War interrupted their aspirations and the car never got into production.

Several other European pre-war designs for rear-engines—the English Crosley, the German Mercedes-Benz, Czech Tatra, Italian Isotta-Fraschini, French Renault and Hitler's Volkswagen—got along well enough by European standards. But that was principally because their size, speed and styling were so far under American par for the production line that major problems didn't develop. Most of the small cars with little horsepower couldn't go fast enough to get the front-end sway. Engine-cooling was of so little consideration that in the 8-hp Renault, for instance, the radiator was behind the engine.

Then, of course, came Tucker with his plans for a posterior-powered jalopy with more trunk space, more power, better vision, more safety, better brakes, better



See anything strange about that car at the top? It's a six-wheel Pontiac. Dual tires help carry the weight of the motor, set where the back seat used to be. That box, lower cut, hides the engine.

Man with flying hair, top, is W. B. Stout, who is testing aft-engined car he built of glass. The fabulous Tucker, above, gets its push from the 150-hp motor in the rear. Note the six exhausts.

styling, etc., at the same cost as a conventional auto. But production-line Tuckers still haven't made their appearance for general distribution and it looks like Tucker's dream won't come true (at this writing, anyway).

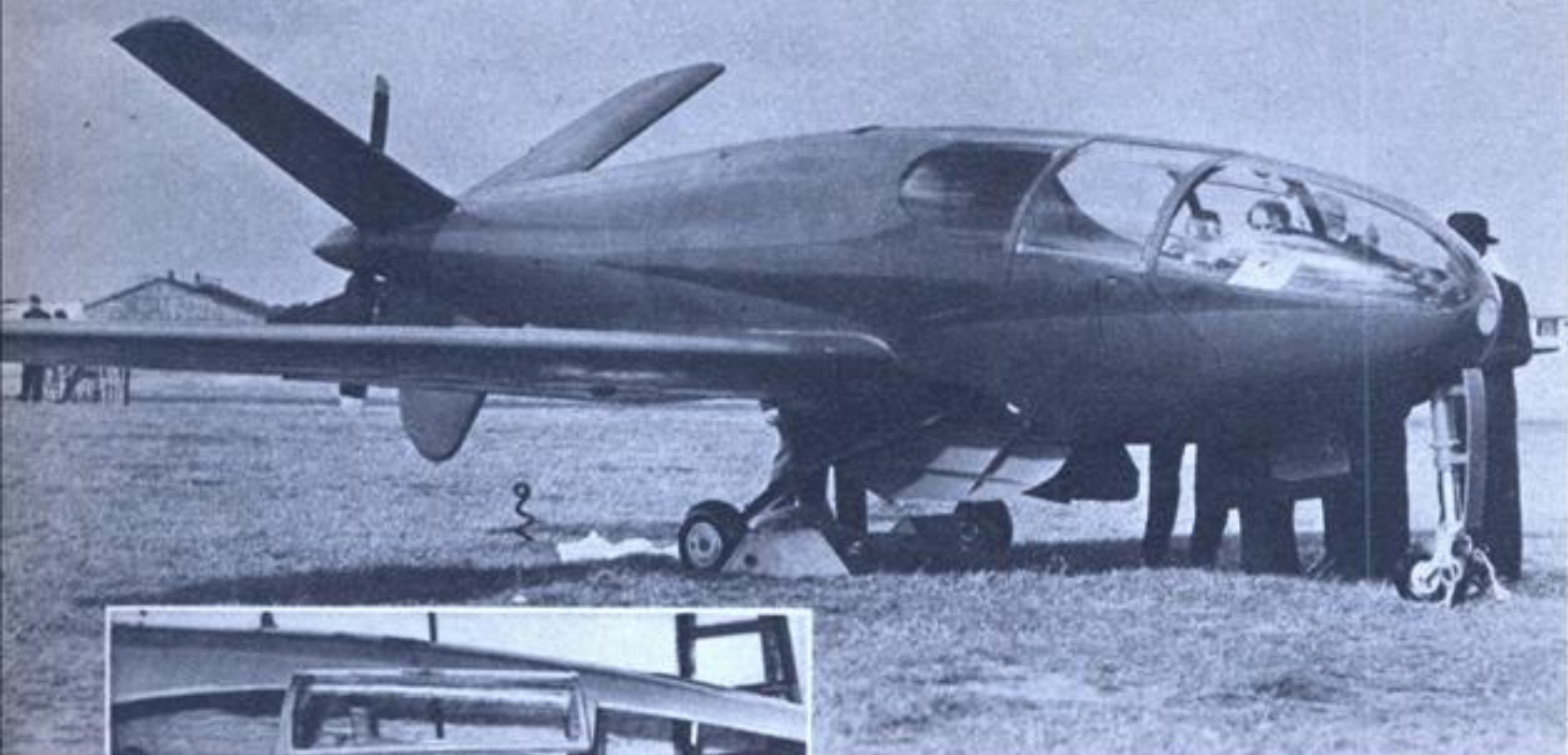
One day in 1946, an automobile that appeared to be an ordinary Pontiac sedan stopped at the New York mouth of the Holland Tunnel to pay the toll before proceeding to New Jersey. The attendant, casually preparing to charge the regular fare, let his gaze wander downward. He stopped short! The car had twice as many rear wheels as an ordinary private car. Like a bus, he thought. So he upped his fee to the bus category—a few cents more.

This special six-wheel rear-engine job, put together in New York for General Motors, has since been driven, dissected, patted, pooh-poohed and praised by scores of engineers.

Results? The tests kindled some enthusiasm. Its dual tires had unusually good traction on any kind of road surface. On snow, ice or gravel it performed better than others. It didn't "fishtail" on slippery surfaces while gathering speed. The light front end made steering easy, without the tires side-slipping on a sharp turn. But that's about where its advantages stopped.

What are some of the arguments against the rear-engine design? One of the principal ones is weight distribution. With the heavy motor over the rear axle, the center of gravity of the car is shifted to the rear. This means that when not under complete control, the car will have a tendency to turn around and travel backwards, like an arrow shot tail-first. When skidding on ice, for example. Then, too, in case of an accident, the heavy rear moves forward, telescoping the car and its occupants. Even the rear-engine boys [Continued on page 155]

Tail-Prop Plane

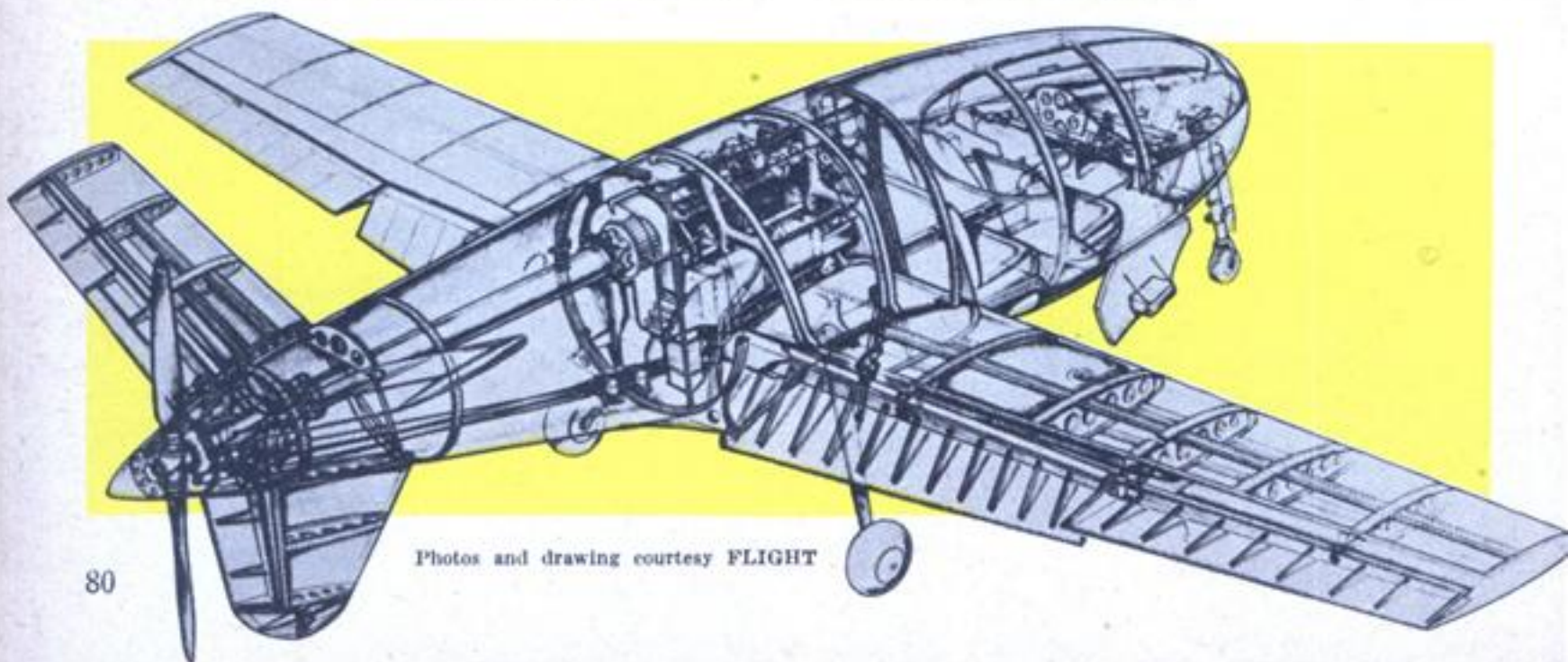


Cabin is as roomy as an automobile. Seats are set directly on the floor with foot wells for passengers. Door has combination step and armrest.

A new style in tails has been shown recently to British fliers by Planet Aircraft, Ltd.

The plane, called the Satellite, has a tail prop, V-shaped stabilizers and an inverted fin. The engine, a Gipsy Queen, is mounted directly over the center of gravity and is linked to the prop by a magnesium shaft. A soundproof bulkhead separates the 5-passenger cabin from the engine compartment. Thus all prop and engine noise is directed backward and the cabin is virtually noiseless.

Construction is magnesium instead of aluminum; this metal reduces corrosion and fire hazard. Flaps give it a landing speed of 62 mph. Top speed is 208 mph—not bad for a lightplane!



Photos and drawing courtesy FLIGHT

MECHANIX ILLUSTRATED

AUGUST

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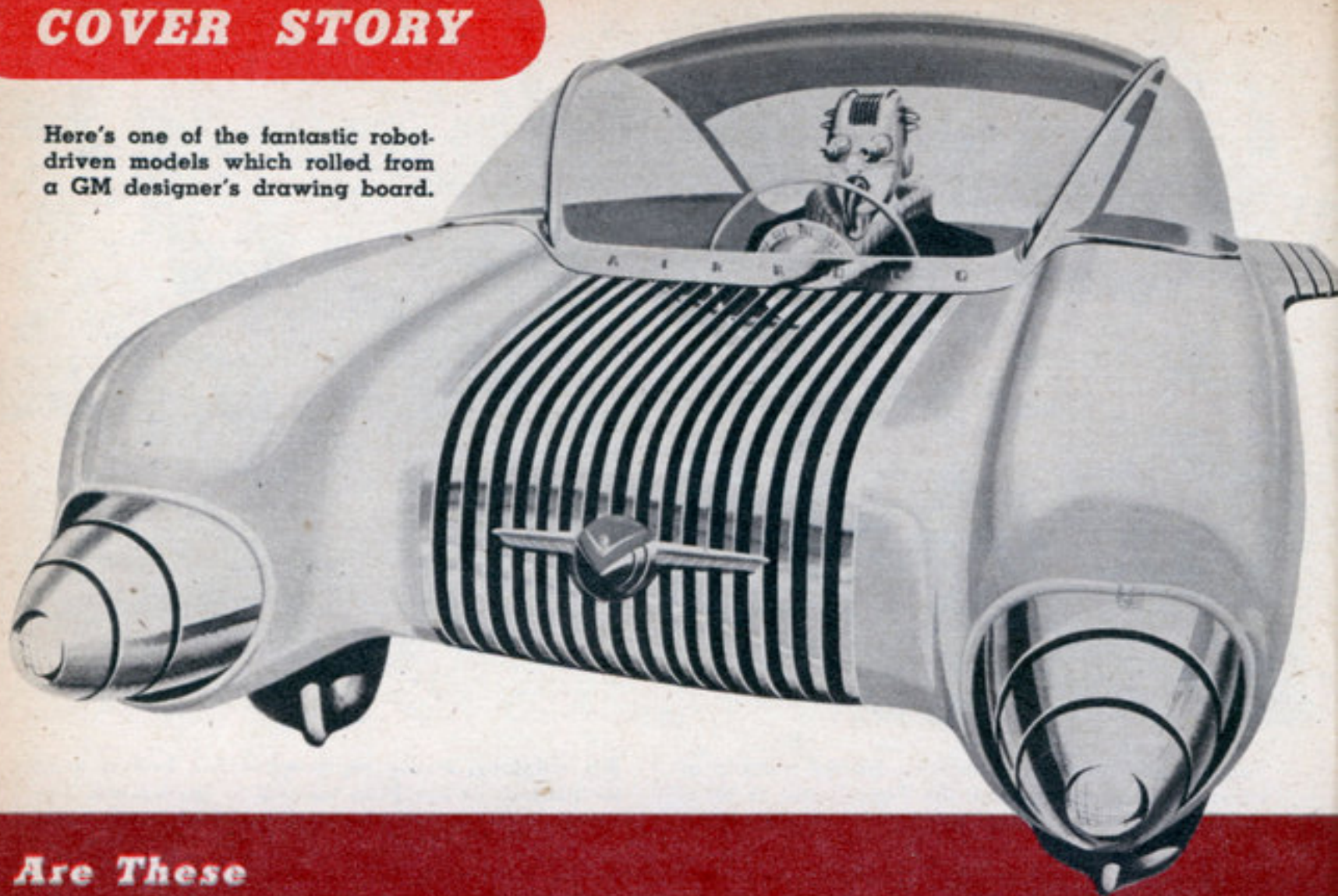


**GM's Car
of Tomorrow?**

See Page 84

COVER STORY

Here's one of the fantastic robot-driven models which rolled from a GM designer's drawing board.



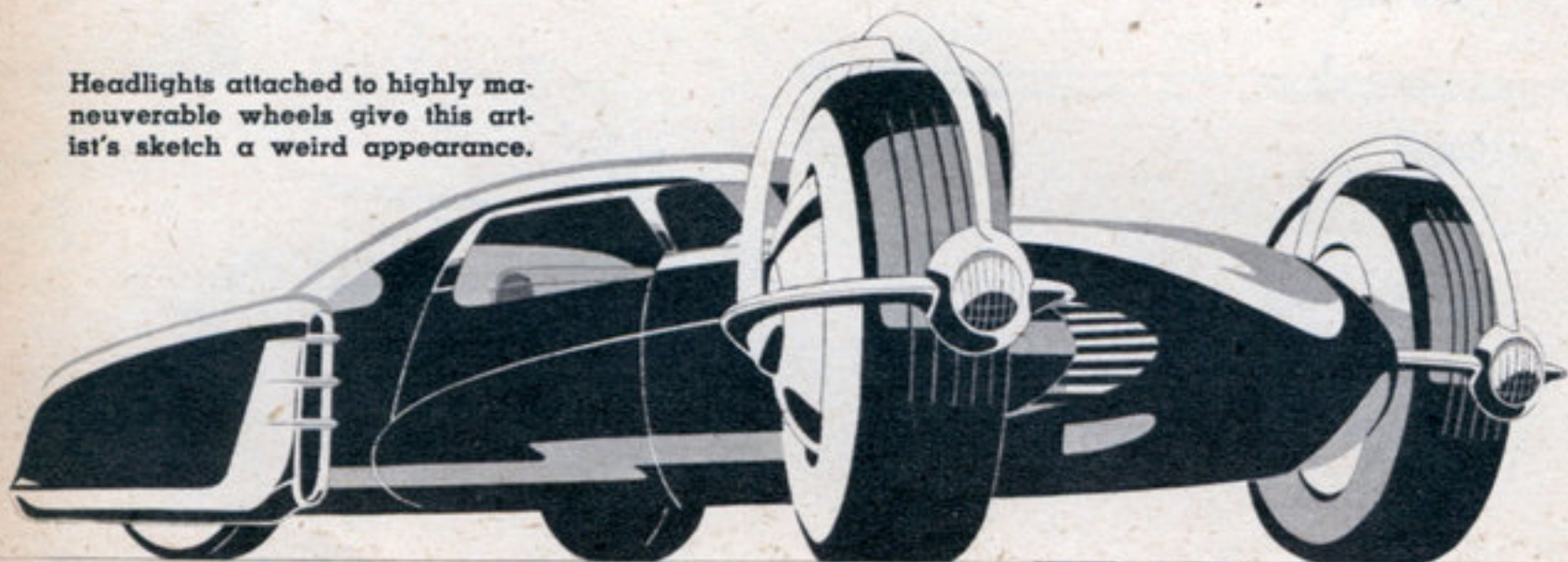
Are These GM's Cars of Tomorrow?

By Bernard W. Crandell

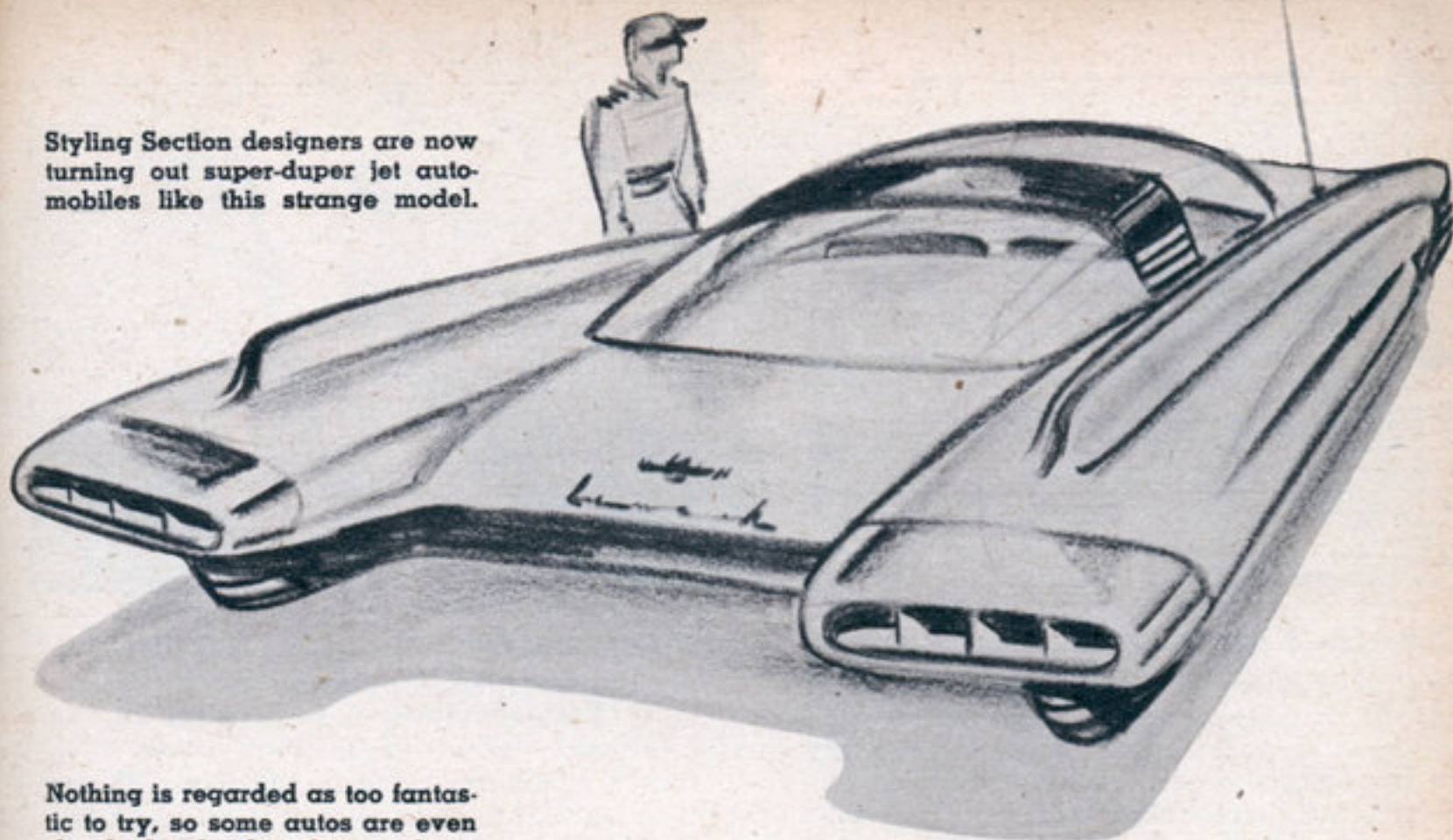
PROBABLY you'll never see any of the fanciful sketches on these pages coming down a production line or in your dealer's salesroom. Nobody at GM intends that you should. The sports car designs here are an important phase of automobile styling done by the General Motors Styling Section and the sketches fulfill a function of professional car designing for which there is no substitute—uninhibited creativeness and daring imagination.

GM designers are developing ideas on paper that run the gamut of futuristic possibilities in autodom—from three-wheel sports runabouts to jet-propelled cruisers steered [Continued on page 158]

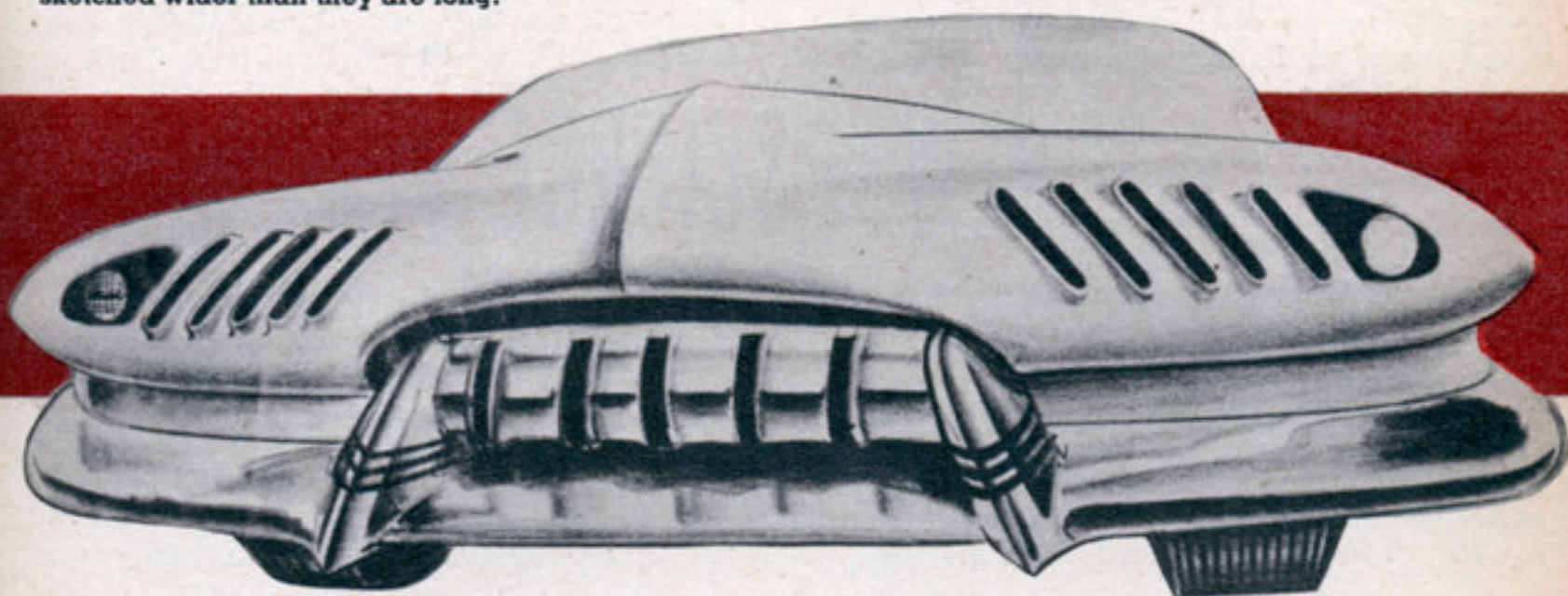
Headlights attached to highly maneuverable wheels give this artist's sketch a weird appearance.



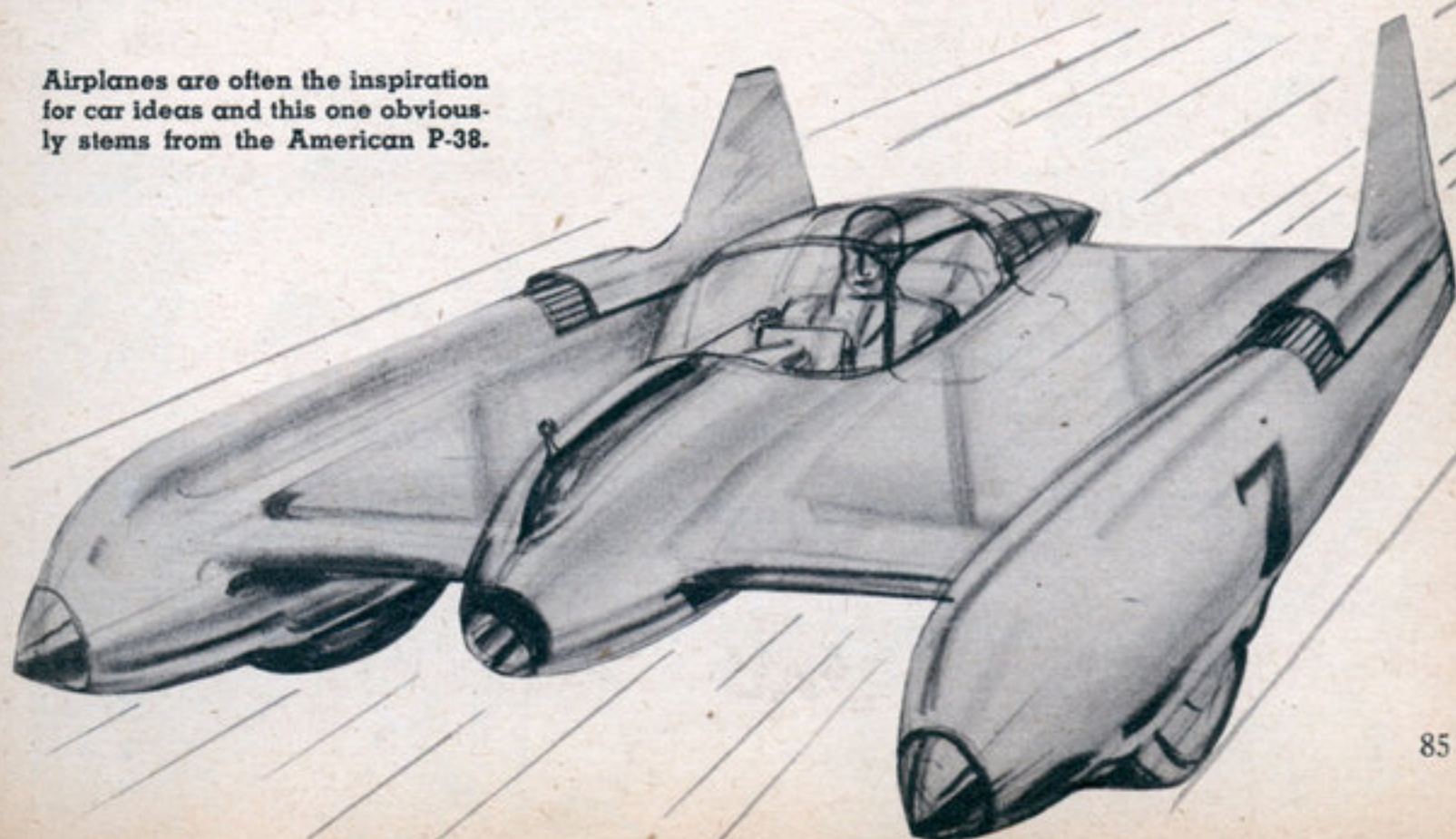
Styling Section designers are now turning out super-duper jet automobiles like this strange model.



Nothing is regarded as too fantastic to try, so some autos are even sketched wider than they are long.



Airplanes are often the inspiration for car ideas and this one obviously stems from the American P-38.



Are These GM's Cars Of Tomorrow?



Artists in the General Motors Styling Section are free to doodle to their heart's content. Note that the walls of the office are lined with discarded brainstorms of the large staff of top automobile designers.



Not many of the designs ever get to the advanced stage pictured at top. One of GM's cars of tomorrow gets the once over from a regional winner of the Fisher Body Craftsman's Guild competition, above.

[Continued from page 84]

down the highway with a radarscope. Some hug the road so tightly that the tops of the wheels are higher than the driver's head. Others are replicas of some of the world's well-known fighter planes—P-38 Lightnings, P-51 Mustangs and both U. S. and British jet jobs.

Fantastic? Certainly not. Aviation's influence on car styles has long been noted, for airplanes symbolize the speed, trimness of line and streamlining that car owners want in their own vehicle. Perhaps a vertical stabilizer here or a jet air intake there will be translated by the automobile stylists into a tail fin or decorative chrome trim for the leading edge of the rear fender.

The designers of these super-duper sports models work without any thought of engineering restrictions or practicality. They have not been told "you can't do this because. . ." They live in the world of the future, when atomic engines and new engineering principles permit entirely new concepts of styling.

Sketches of the designer's dream are dashed off in pencil on ordinary pieces of white writ-

ing paper or yellow copy paper well-known to the newspaper trade. If the designer has a really new idea, he may be told to make a water color rendering of it, dressing it up in color and painstaking detail to achieve the ultimate effect. From here on, the mortality rate of designs increases for the next step is an expensive one.

Harley J. Earl, Chief of GM Styling, orders only a few renderings to be made up into plaster models, scaled to the proportions of an ordinary automobile. These plaster models, painted and trimmed into beautiful miniatures of what life-size versions would be, are then available for study by the executives of the five GM car divisions.

Never has one of the plaster models been accepted in its entirety for a future production model. But, it might be a strikingly handsome bumper-grille, or a sweeping fender line on one of the sizzling little jobs that strikes the eye of a car-division boss. That one feature might be what he wants on his 1954 model.

So, look carefully at the sketches on pages 84-and 85. There might be something there you will recognize on a new GM model several years from now. •

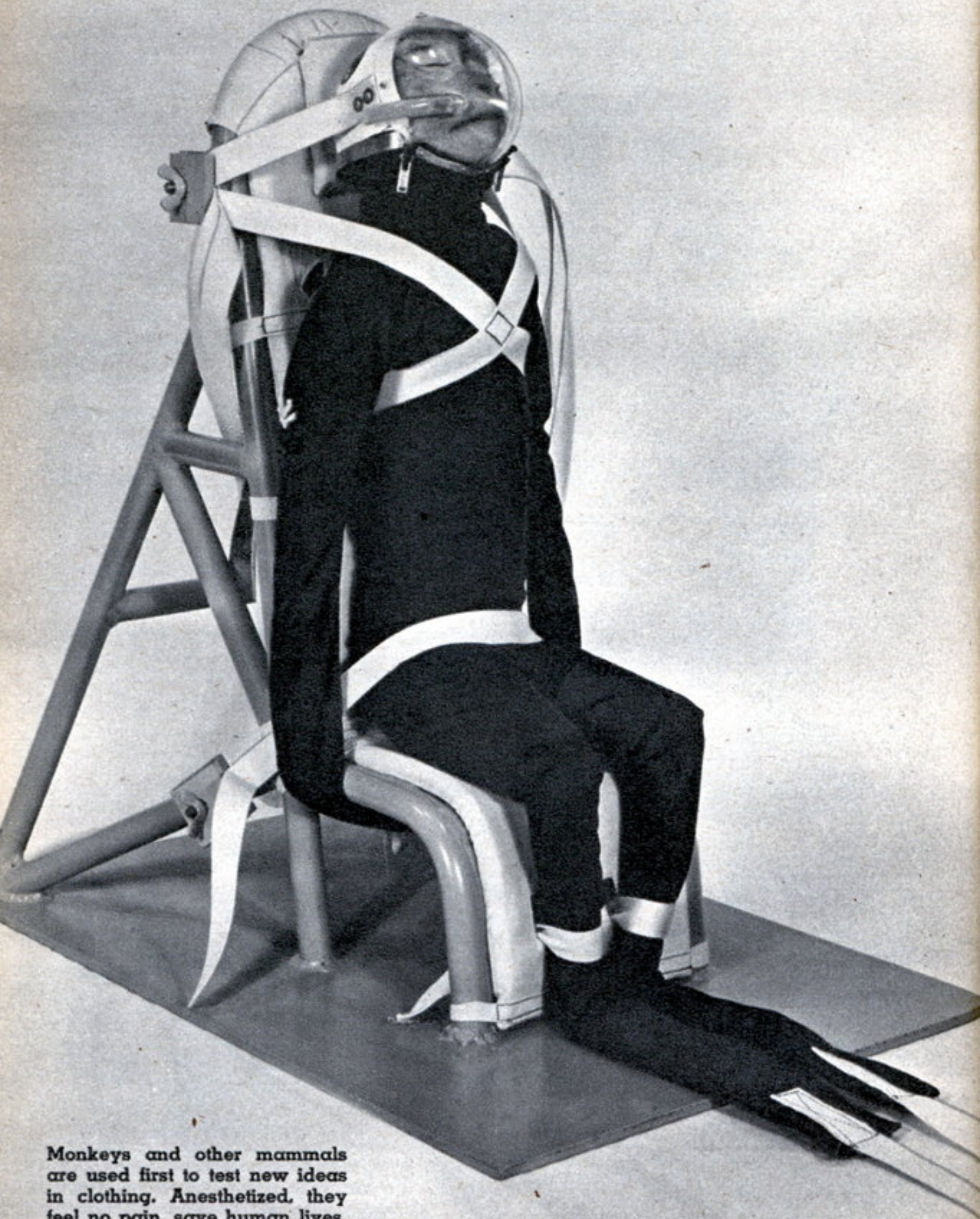
HERE'S WHAT WE'LL WEAR

Designers are already working on the styles the well-dressed space man needs to survive.

Emergency pressure cell designed to provide crew members with individual atmosphere if ship leaks.



Animals and men both contribute to the development of space clothing



Monkeys and other mammals are used first to test new ideas in clothing. Anesthetized, they feel no pain, save human lives.

in the endless search by aeromedical scientists for safety and comfort.

By Lloyd Mallan
Author of Men, Rockets And
Space Rats

IT MAY or may not be true that clothes make the man, but one thing is certain: when he starts traveling in outer space his life will depend on the clothes he wears. For the past decade a unique group of clothing stylists has been hard

at work determining the cut and materials of future fashions in space dress. None of this group is a designer by profession. Among its varied members are biophysicists, physiologists, anthropologists, electronic scientists and doctors of medicine. But they have one thing in common: all are willing to risk their own necks to perfect equipment that will make it safe for other men to fly through the alien vacuum of space. Acting as



The contourometer is only device of its kind in world. At Wright Air Development Center it is used to study head, body form.

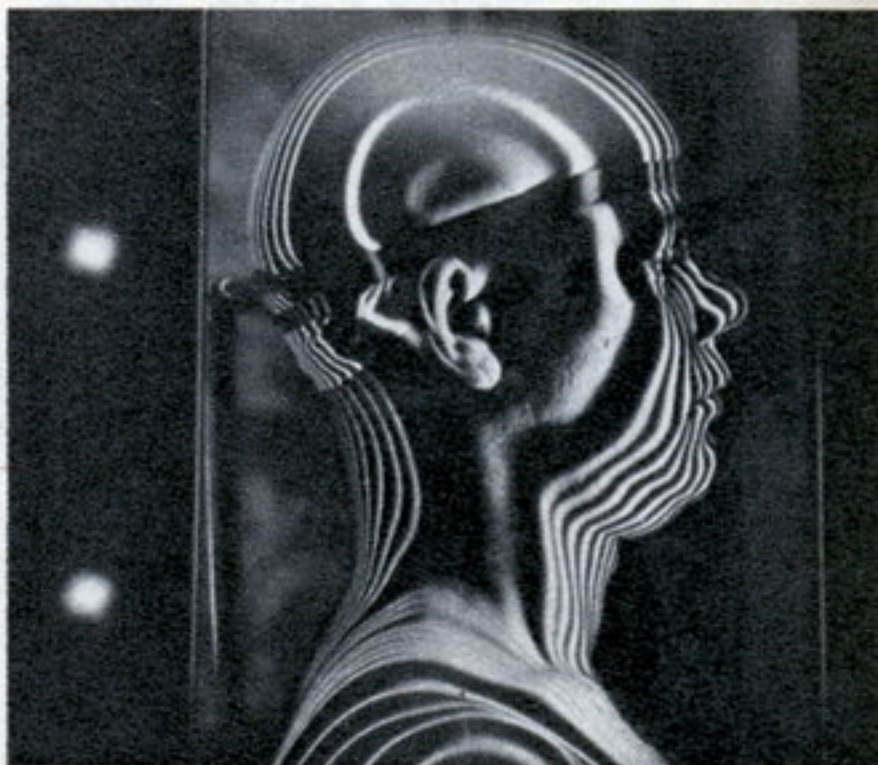


Photo taken by the contourometer shows the designer variations in head shape so that pressure helmets can be built for comfort.

Experimental vibrating helmet developed by anthropologists at Wright massages to prevent discomfort at high acceleration.

The MA-1 helmet, newest in Air Force, has wider vision, more comfort, greater safety than previous models. Photo is by author.





Mammals try out all kinds of oxygen masks. This is used for counterpressure against gravity.

Explosive decompression, shown at left, is one of the biggest threats to life in outer space. Beyond 63,000 feet atmospheric pressure is so low that normal body temperature is hot enough to boil human blood. Man in the pressure suit is safe but beaker of water in his hands will explode to frothy boil without fire.

Problems of living in the alien vacuum of space are being solved.



their own guinea pigs, they are locked into altitude chambers, spun wildly on centrifuges, and closed up in insulated rooms. In the process, they discover whether or not their space fashions are practical. And in order to be absolutely certain they plunge needles into their veins and spines, under their skin and over their brains. Wires connected to the needles carry their slightest physical reaction.

But out of it all, in just ten years, have come the means to prevent the horrors that could happen in space to the unaccustomed human body. Aeromedical scientists at the Air Force's Wright Air Development Center (who supplied photos on these pages) now know that man can fly beyond the atmosphere without his tissues exploding, brain hemorrhaging, blood cells dying or lungs collapsing. •

◀ St. Bernard helped in series of tests to develop insulated clothing. He felt no ill effects at low temperatures and pressures.

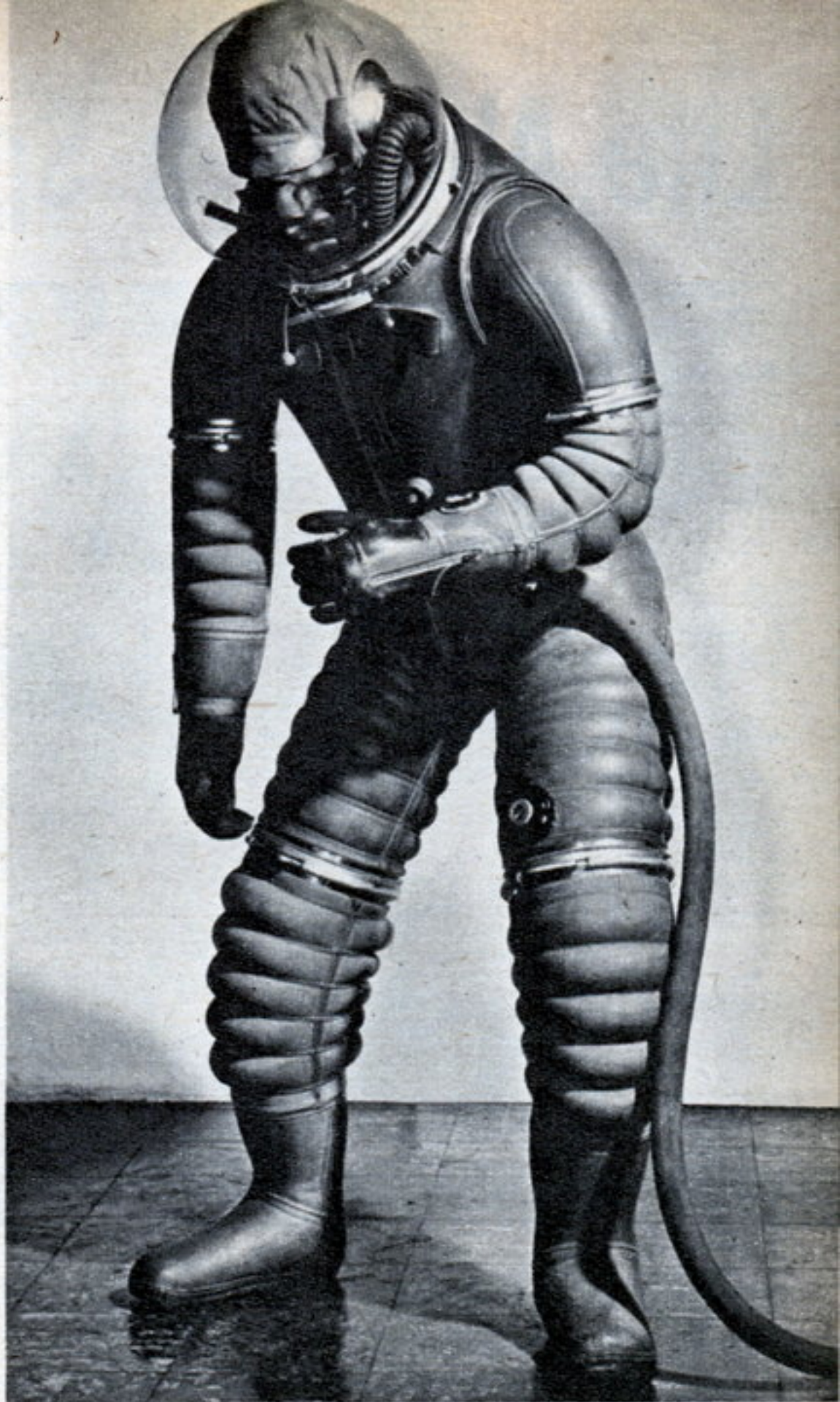


Special plastic helmet supplies pressurization for entire head while subject undergoes negative gravity tests on centrifuge. It was found this ended red-out.

Early full pressure suit was not efficient. It looks impressive but it was clumsy and restrictive. Air Force has developed new space suit; the design is Top Secret.

Photo at near right shows one of newest developments: a suit that is air-conditioned. Worn as a liner to full pressure suit, it dispels asphyxiating body heat.

At far right is one of earliest experimental partial pressure suits with full pressure helmet. The combination worked but was not as good as new models.





Conquest of Space

COAST-TO-COAST IN 40 MINUTES

By G. Harry Stine

Three hundred miles up at two miles per second, then an 1,800-mile toboggan ride—that will be the new transcontinental rocket.

Gasoline and liquid oxygen fuels will be pumped when ship is in vertical position.

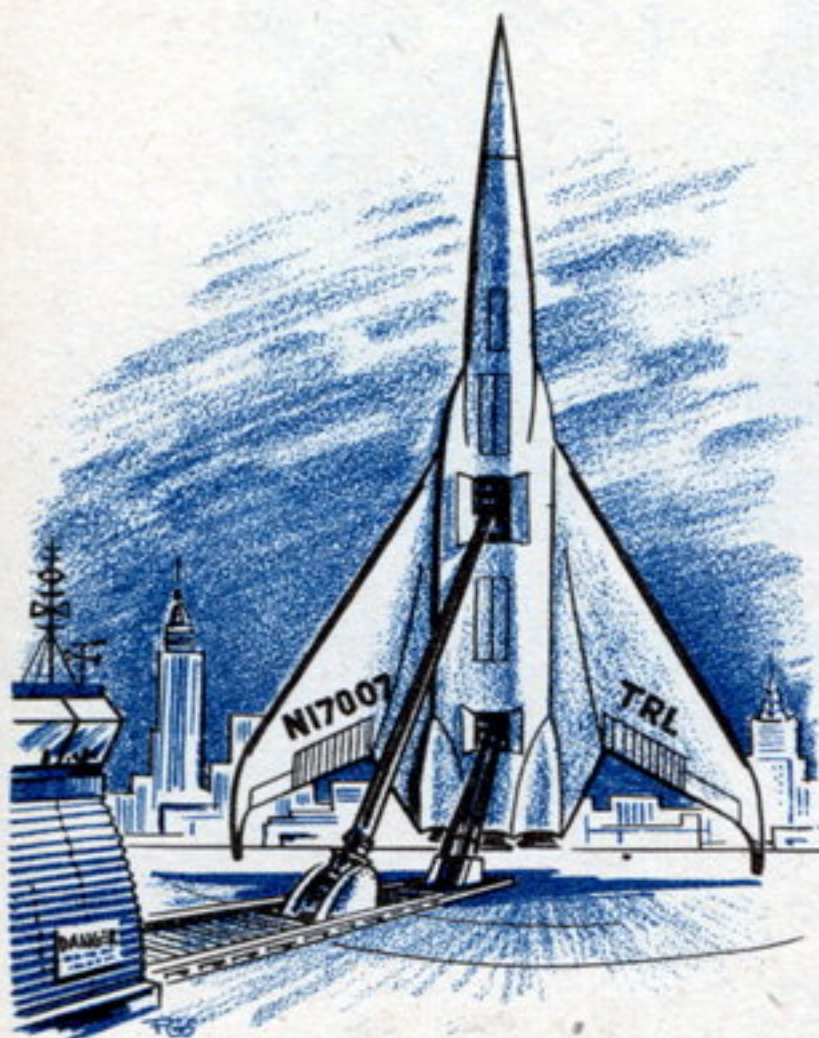
IN A RELATIVELY short time you may be able to have lunch in New York City, hop aboard an airliner, and have breakfast in Los Angeles the *same day!* The present seven-hour plane trip will take only 40 minutes.

Let's slide forward a few years. The place is just outside New York City on a cold, blustery day. Inside the passenger terminal, luncheon is being served in the restaurant. It looks like an ordinary airline terminal except for the signs over the desks: Transcontinent Rocket Lines, Atlantic Rocket Service and others. We check in at The Transcontinent Rocket desk where our baggage is carefully weighed—along with ourselves. Weight has always been a prime factor in rocket work.

When our flight is called we rapidly finish our light lunch and head for the boarding gate. Now, its silver sides shining coldly, a huge rocket transport stands beyond the gate, 80-foot delta wings spreading over the concrete ramp. Three rocket nozzles gape from the rear of the ship. It looks more like a very fast jet plane than a rocket. But its average speed across the continent will be 4,500 mph!

We climb a stairway into the belly of the craft where a stewardess, after consulting her weight-distribution sheet, directs us to a seat next to a window in the forward part of the cabin. The cabin looks much like a 1956 airliner's except for the seats.

As we settle down, the stewardess comes around to explain that the seats are built to stay "under" us at all times; that is, they will automatically swing to





Giant transcontinental passenger rockets will look much like jet bombers of today.

support us under the terrific accelerations of the ship.

Then the belly hatch is closed and the ship is towed out onto the big field by a tiny tractor. It stops next to one of the big concrete flame pits, partially filled with water, which cool the rocket flame during the take-off to prevent it from damaging the ship.

The ship suddenly tilts up, being lifted to the vertical position by a device much like those used for the same job with big guided missiles. Within a minute, the transport is standing vertically on its wing and rudder tips over the flame pit. Then the ground crew is swarming over it, attaching big hoses through which the rocket propellants—liquid oxygen and gasoline—are quickly pumped into the ship. Over 60 tons of propellants are put aboard, more than two-thirds the takeoff weight of the ship!

Our watches show it is 11:50 a. m., New York time. The ship is now ready to go but the pilots up in their cabin must still complete an elaborate set of checks and tests. Once the rocket transport is on its way, there will be no turning back.

Then, over the loudspeaker comes the warning, "Stand by for lift! One minute to zero!"

We are securely strapped into our seats which have swung so that we are now lying on them.

"Thirty seconds!" Things start happening. There is the high whine of motors and gyros, the hiss of pressurized gas, the muffled slam of valves.

And: "Zero!" A thundering, muffled bellow assaults our ears. The rocket motors have started as scheduled, on

the dot of noon. There is a slight vibration, then we are being pushed into our seat-couches by a tremendous force.

If we could watch, we would see the ground slip quickly away, the clouds slide by and the sky growing progressively darker. But the acceleration of the ship has us pinned to our seats. It is, however, only a force of about three g, and men have taken much higher acceleration without discomfort.

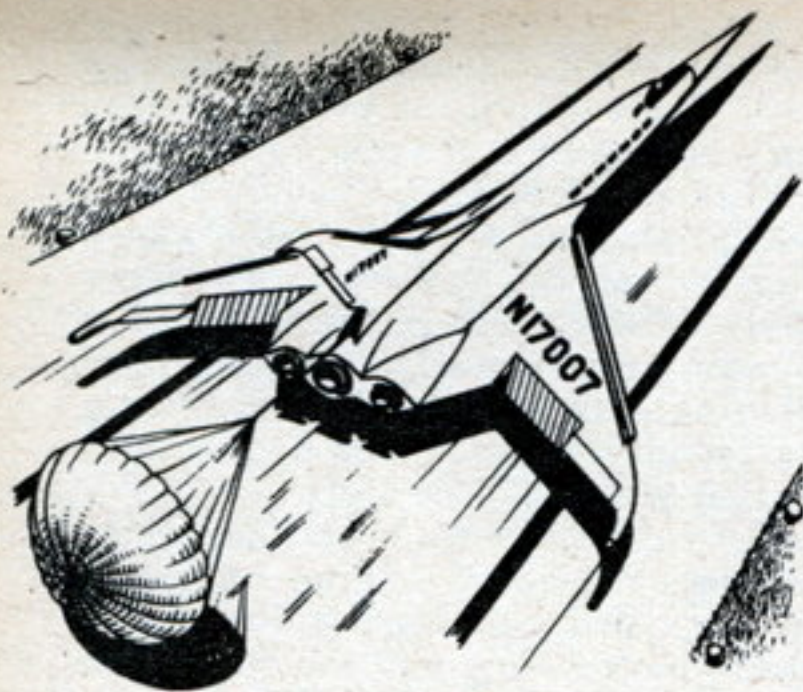
The rocket motors keep burning for only two-and-a-half minutes. Once the proper speed has been built up, the rocket motors stop and the ship coasts upward like a giant artillery shell, aimed across the continent.

At this point, the ship is moving at nearly two miles per second and is about 100 miles up. We have been given the same two-mile-per-second velocity as the ship, and when the motors stop, we coast upward with the ship. And we suddenly feel ourselves *falling*!

But we are falling *up* with the ship. So we do not detect gravity. We are

Seats will swing back to form acceleration couches during powered climb to 300 miles.





Drag chute will slow ship down for landing.

in that strange state known as sub-gravity, or free-falling. We have no apparent weight. This does not cause discomfort; two decades of experiments by test pilots and flight surgeons have preceded this trip. Even back in 1955 they had learned that zero-gravity does not bother a person provided he is strapped down as we are.

By the time we reach our peak altitude of 300 miles and start falling back toward the ground, the Earth can be seen as truly round. The Great Lakes are visible, as is Hudson Bay far to the north. The sky is velvet black. The

cloud banks below shine pure white, reflecting sunlight.

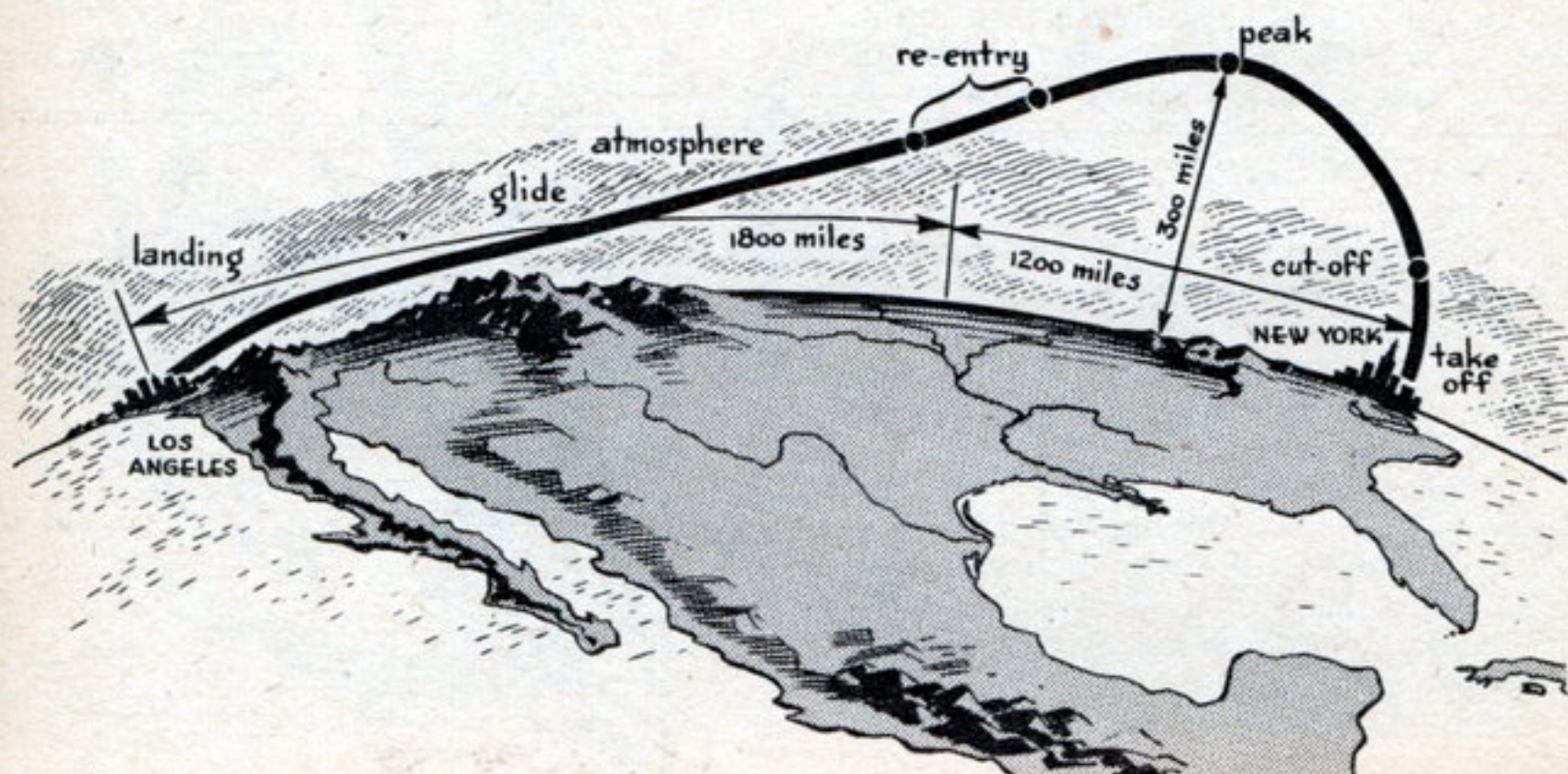
Now we are falling back toward the ground somewhere over Illinois. Ordinary test rockets would come screaming in to hit the ground if they were making such a flight. But, thanks to some research conducted by Dr. Hsien-Tsien at the California Institute of Technology, we will not crash. Back in 1949, he laid out the basic course or trajectory we are now flying.

At about 25 miles altitude, there is just enough atmosphere outside so that the bat-like delta wings can begin to have effect. They lift. Rudders and ailerons are effective again. Air streams past the ship, more and more of it as we dive deeper into the atmosphere.

Then our seats change position again and the pilots bring us slowly out of our dive and into level flight. The big transport slices through the upper atmosphere; it is now a supersonic glider with its nose pointed toward Los Angeles. Falling from 300 miles altitude has given us enough speed to glide the remaining 1,800 miles to the West Coast.

The Great Plains of Kansas are under us now, wrapped in the thick of a blizzard of which we can see only the distant tops of the clouds. The high Rocky Mountains are under us in a matter of

The planned trajectory of the westbound transcontinental passenger rocket.





G. Harry Stine, who will be skipping MI's new rocket and space travel column, is Viking-Aerobee Operations Engineer at the U. S. Naval Ordnance Missile Test Facility, White Sands proving ground, N. M. In his professional work he is currently involved in upper atmosphere sounding rocket research. Thousands of science-fiction readers know him by the pen name Lee Correy. He has published two books for young people—*Starship Through Space* and *Rocket Man*.

minutes. They look like tiny wrinkles in the surface of the greenish-brown earth.

The leading edges of the wings are glowing red-hot from the compression and friction of the air at this tremendous hypersonic speed. But their high-temperature alloys will not melt away. Were there not 25 years of rocket research behind us we would be in trouble because the ship has been encountering the so-called thermal barrier ever since it got back into the lower portions of the atmosphere. Air conditioning keeps the cabin temperature comfortable.

The Earth loses its apparent curvature quickly as we pass over Nevada. Up forward, the pilots are vectoring on Los Angeles with radar and talking to the rocket port tower there by radio. Then the Sierra Nevada range slides beneath us and we can see roads and fields and towns again. The ship slows noticeably as the big flaps and air breaks are extended. Then the big landing gear drops out of the fuselage . . . and we are over Los Angeles, still gliding, but heading for a landing under the controlling hand of the great-grandson of the GCA instrument landing system.

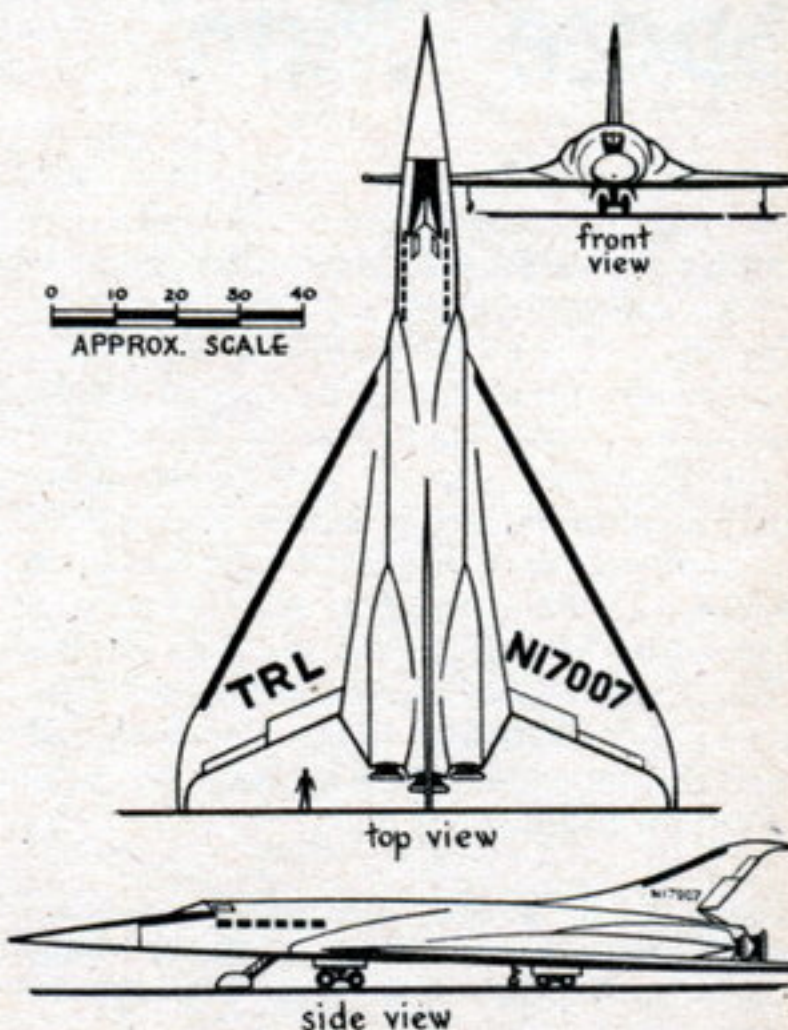
There is a squeal of tires as the ship touches the runway and the big drag parachute billows from the tail of the ship, dragging us to a quick, smooth halt. We are down in Los Angeles. The time is 12:40, New York time. The sun over the eastern horizon tells us something else, however. It is only 9:40 a. m. here in Los Angeles. We have

raced the sun across America and won!

Such a rocket flight is not a fantastic dream to the men who are working with rockets today.

In the midst of all this research, rocket men can foresee a time when such a rocket trip from coast to coast will be a reality. There are problems remaining to be solved, certainly. But they are engineering problems and they can be solved. After that it will be only a matter of building "hardware" and making tests. •

Three views of the rocket ship. Note the triple rocket nozzles, passenger stairs.





The North Sea may yield up treasures lost to man before the pyramids were built.

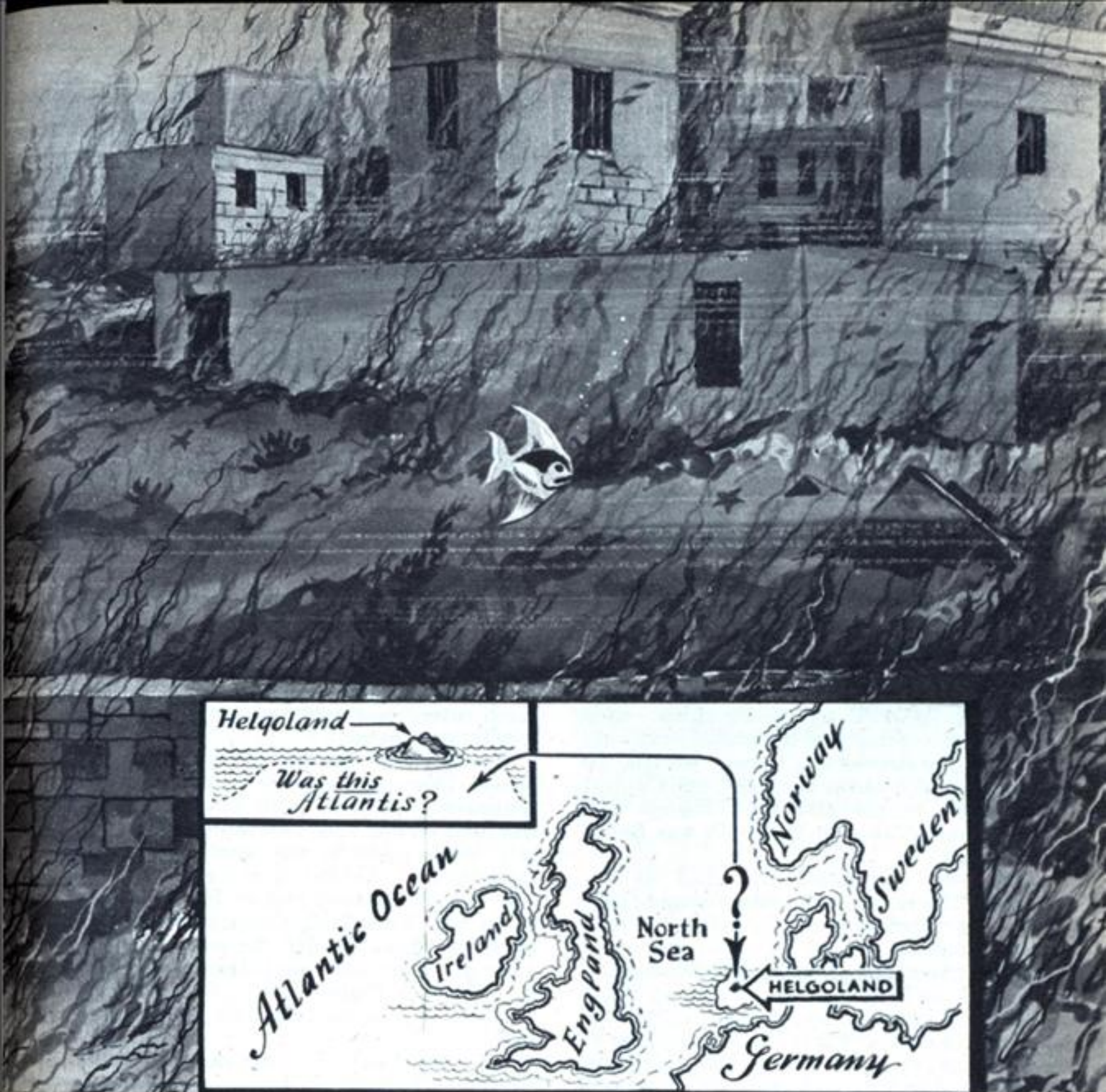
HAVE THEY FOUND

A noted German archaeologist believes he has uncovered the grave of the fabulous city that sank beneath the sea.

By Robert Martin

A TENSE drama was being enacted in the North Sea.

A deep-sea diver was exploring the ocean's floor as a scholarly looking man stood by the rail of the vessel anchored fathoms above, his ears glued to the head-piece of a telephone line. Suddenly the diver's voice came crackling over the wire. He had seen something incredibly strange in the phantom world beneath the sea. The man aboard the ship listened intently, then paled. His heart began thumping and his



THE LOST CONTINENT?

hands shook.

Was this the climax of the oldest, longest and most tantalizing hunt man has ever waged, a hunt that has been going on for the unbelievable span of 11,500 years?

Was this to be the greatest geographical and archaeological find of all time?

Was this, in short, the discovery at long last of the legend-shrouded lost continent of Atlantis?

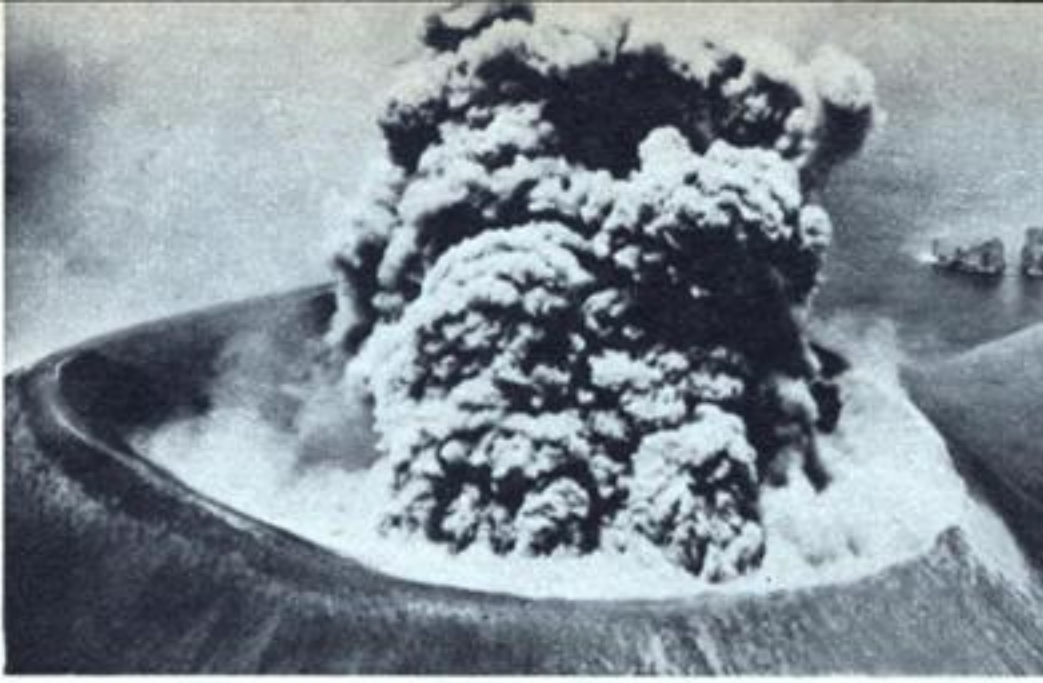
The man on shipboard, talking with the diver, was Dr. Juergen Spanuth, a 46-year-

old German pastor and archaeologist, who was in the midst of his third gruelling expedition to locate the remains of the fabled island.

What, exactly, did his diver find to convince him that he had reached the end of his search?

But first, the story of Atlantis, the weird tale of a vanished land that has intrigued mankind through the ages:

The incredible story was first told by the philosopher Plato, who wrote about it in



A mighty volcanic upheaval such as this recent one in the Pacific may have swallowed Atlantis.

Columbia University's John Ewing lowers automatic camera that will photograph ocean depths.

his famous Dialogues in 400 B. C. Atlantis, he said, was an enormous island, larger than North Africa and Asia Minor combined, which was situated squarely in the middle of the Atlantic Ocean. It lay just beyond the "Pillars of Hercules"—now called the Straits of Gibraltar—and included the Azores and Canary Islands. To the west of Atlantis lay North and Central America, to the east were Europe and northwest Africa, to the south was South America.

A great civilization flourished on Atlantis. The people were virtuous and God-fearing, tilled their fertile soil and reaped an abundance of food, aromatic plants and exotic fruits. The government was a federation of ten kingdoms, each ruler an absolute monarch and all pledged not to war on one another. There were fine cities of imposing architecture on the continent, with gold and jewel-encrusted temples and royal palaces bulging with fantastic treasures of every description.

The Atlanteans, however, were power-hungry. Their far-flung empire already stretched from the Straits of Gibraltar to Egypt. They wanted more; they wanted to engulf both Egypt and Greece. And so a war of aggression was launched, a war which never saw an end.

A dreadful night came upon Atlantis, a night which brought horror and destruction on a scale never witnessed before or since by mortal man. A series of massive earthquakes and volcanic explosions rent the entire continent—the earth buckled and heaved. Houses, temples, public buildings, palaces fell like kindling wood. Entire cities were swallowed whole as the earth parted. Mountains crumbled and great plains were overrun by hot, smoking rivers of lava

from the belching volcanos. Then giant tidal waves rolled in from the sea and hurled themselves upon the land. Mountainous floods raced inland, covering plains, forests and inhabited areas. And still the earth roared and quivered, ripping, swallowing, destroying.

Finally, came one last devastating upheaval. Down into the sea sank the entire continent of Atlantis with its culture, its treasures and its 50,000,000 souls, destroyed in a single night by the most convulsive cataclysm ever visited upon the world.

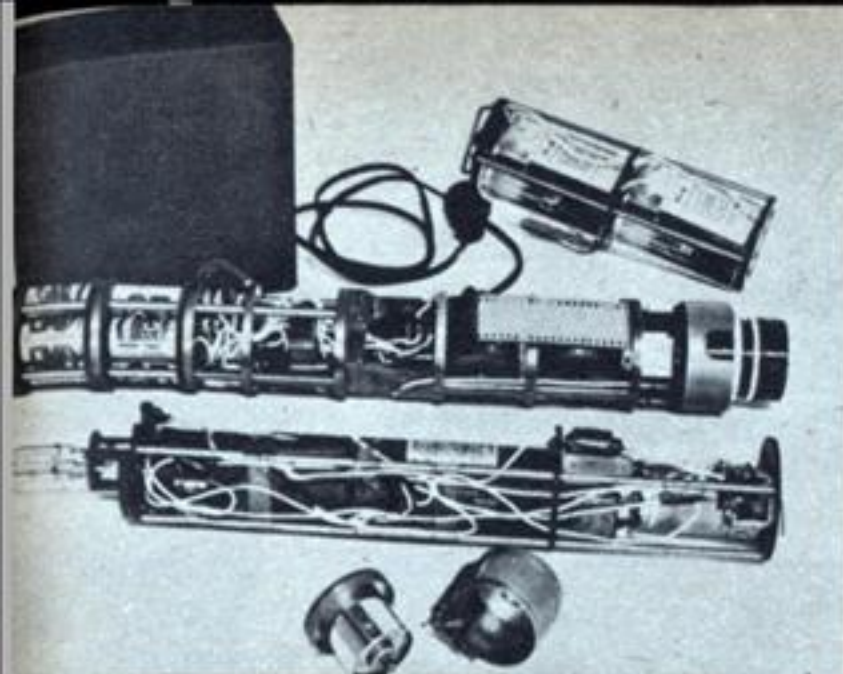
It happened, according to Plato, 11,500 years ago. Since then, century after century, men have roamed the seas, seeking clues as arguments raged. The search still goes on. Was Plato writing of a mythical kingdom or was he recording actual history?

One who believes Atlantis actually existed is Dr. Spanuth. Late in the summer of 1952, the minister-archaeologist set out from Husum, a German port, on his renewed search. His entire life's savings had been poured into the attempt. On board were a geologist, an underwater photo expert, several divers, a stenographer and a shipload of modern scientific equipment.

Dr. Spanuth, who had spent years studying Atlantis lore, was convinced that the continent actually laid buried in the North Sea, not far from the dikes of his own native coastal village of Ost Bordelum. So he steered a course toward the rocky island of Helgoland, circled it and dropped anchor about six miles away. Down went a diver.

What did the diver report that blanched the face of the pastor as he listened over the phone line? This:

"I see a wall," were the diver's words. It was a wall encircling a large oval area



Parts of underwater camera: battery (top left), power supply (top right), flash lamp (bottom).

1,012 yards long and 328 yards wide. And inside the wall? Large, irregular piles of sand—piles that looked like ruins of buildings covered over by the silt of the ocean. These, Dr. Spanuth hopes, hide the wreckage of a mighty palace and temples of an Atlantean king. Inside he believes, is fabulous treasure the like of which man has yet to see.

But this wasn't all. A diver brought up a cobblestone. "What," Dr. Spanuth asks the world, "would an ancient cobblestone be doing on the floor of the North Sea?" What—unless it is a stone from a street 11,500 years old, where ancient soldiers trod and the carts of tradesmen of a bygone era lumbered, he answers.

Helgoland, the pastor is certain, was at one time the highest mountain on the continent of Atlantis. When the rest of it vanished, the mountain alone remained. As evidence, he goes directly to Plato. After the disaster, the philosopher wrote, only "red rocks of the king's island remained to mark the spot." And this is Dr. Spanuth's clincher: Helgoland is world-famed for its red rocks! In addition, the pastor possesses a map dating back to the ancient Germanic Goths, which refers to Atlantis in the North Sea.

Dr. Spanuth is convinced, too, that Plato erred in spotting the location of Atlantis. Plato, he points out, got his information on this score from Egyptian priests, who could easily have been mistaken because of primitive mapping methods.

But let's go deeper into the fascinating story of the lost continent and the argument currently raging about whether or not it ever existed.

Many eminent oceanographers and archaeologists are [Continued on page 214]



Schooner Vema is employed for deep-sea research by Columbia's Lamont Geological Laboratory.

Development of the Aqua-Lung may be tremendous aid to scientists who explore in shallow waters.



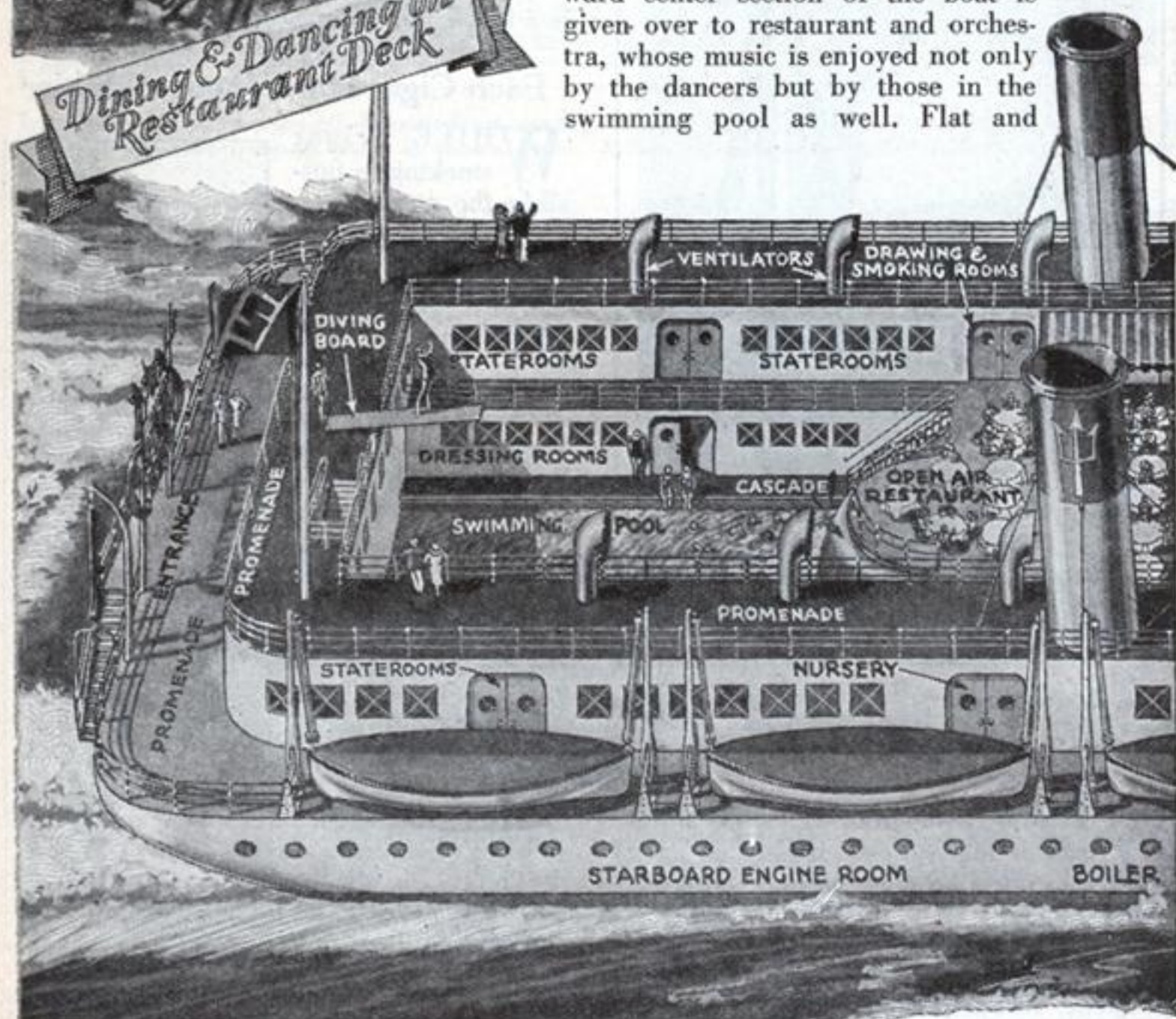
Sea-Going

ONE of the most unique sea-going entertainment palaces in the world is the floating pleasure park being built by Louis Reinsch of Bad Reichenhall, Germany. As depicted on these pages and on the cover of this issue of MODERN MECHANICS AND INVENTIONS, Mr. Reinsch's boat combines features of barge and ocean liner. A movie theater, open air dining space, outdoor dancing, a swimming pool filled with constantly refreshed ocean water and enlivened by a flowing cascade at one end, are a few of the unusual features of the boat; in addition to the usual deck games.

A perforated bottom for the swimming pool keeps water flowing through it constantly when the ship is in motion. The waterfall is kept flowing by an electric pump. The forward center section of the boat is given over to restaurant and orchestra, whose music is enjoyed not only by the dancers but by those in the swimming pool as well. Flat and



Dining & Dancing on Restaurant Deck



The features of the sea-going pleasure park are well shown on this drawing by Stewart Rouse.

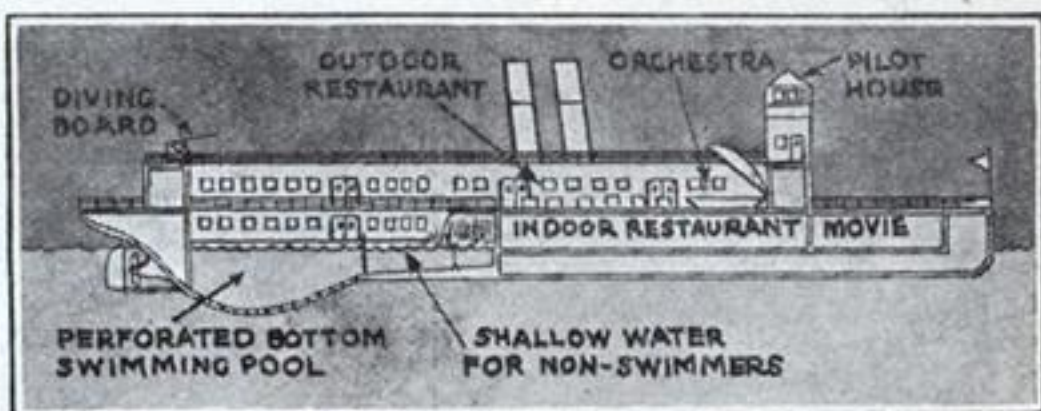
Pleasure Parks

Outdoor Sports
on German Floating
Amusement Palace

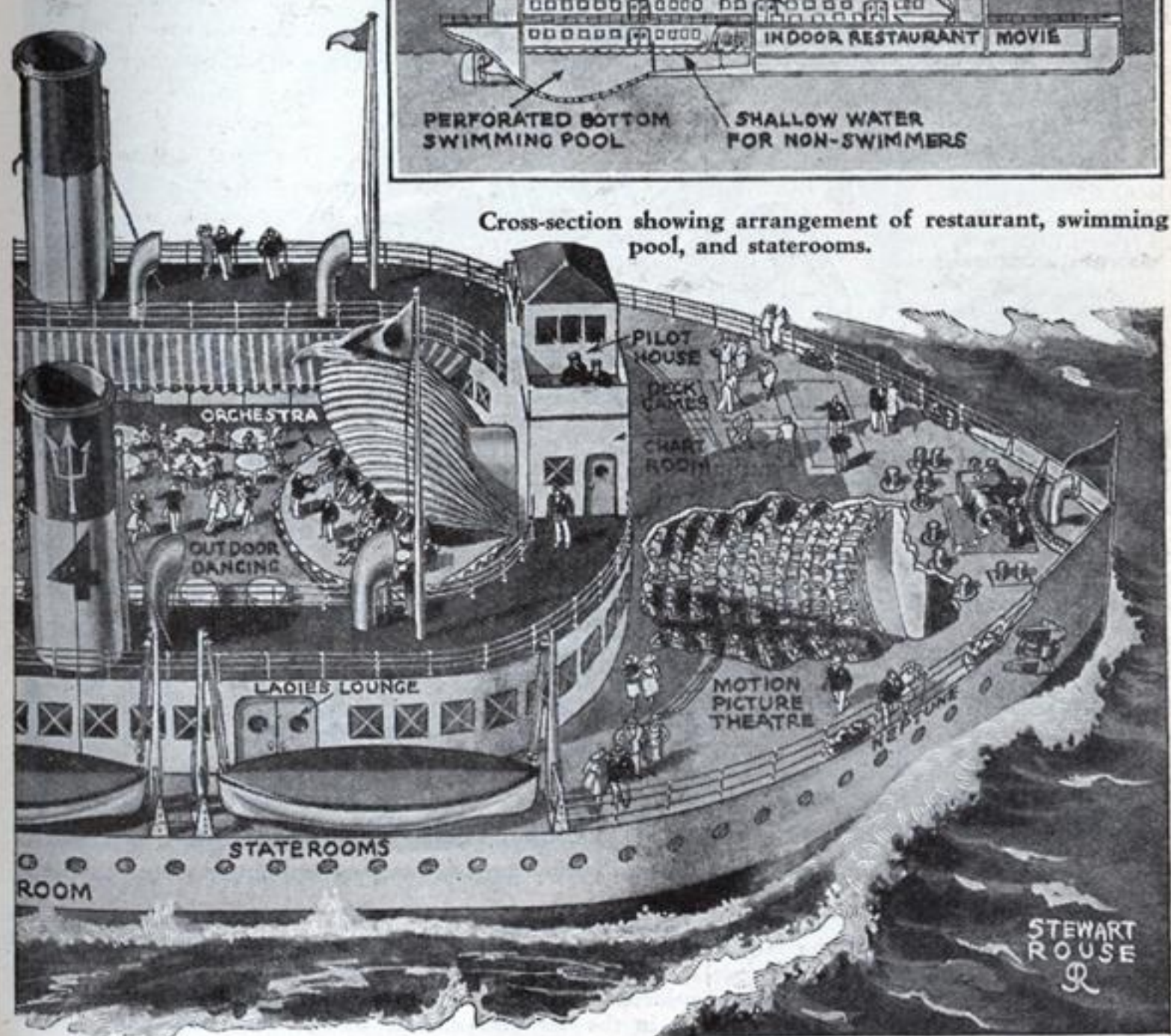
wide in construction, the craft is not designed for speed, but for leisurely cruising in coastal waters. It is not intended that the barge should ply far from shore, since the changing land scenery is one of the features which appeals to passengers out for a holiday, but the ship is perfectly seaworthy and in case of necessity can ride out the roughest sea in mid-ocean.

Since the center of the ship is entirely occupied by restaurant and swimming pool, the designers were faced by the necessity of installing the funnels from the boilers on the sides of the boat. These funnels are taller than ordinary, so the

smoke will not interfere with the pleasure of the passengers. As being built by Mr. Reinsch, the boat will accommodate 750 passengers, including the crew. The first boat constructed will probably be put into service on the French Riviera. Owing to its shallow draft, it is perfectly possible to cruise navigable rivers, and excursion trips up the Rhine, with its beautiful scenery and ruined castles, are contemplated. The first of Mr. Reinsch's unique ships will be put into service next summer, it is hoped.



Cross-section showing arrangement of restaurant, swimming pool, and staterooms.



Note that practically the entire deck of the floating palace is given over to entertainment of passengers.

FAWCETT'S

MAR.
25c

MODERN MECHANICS AND INVENTIONS

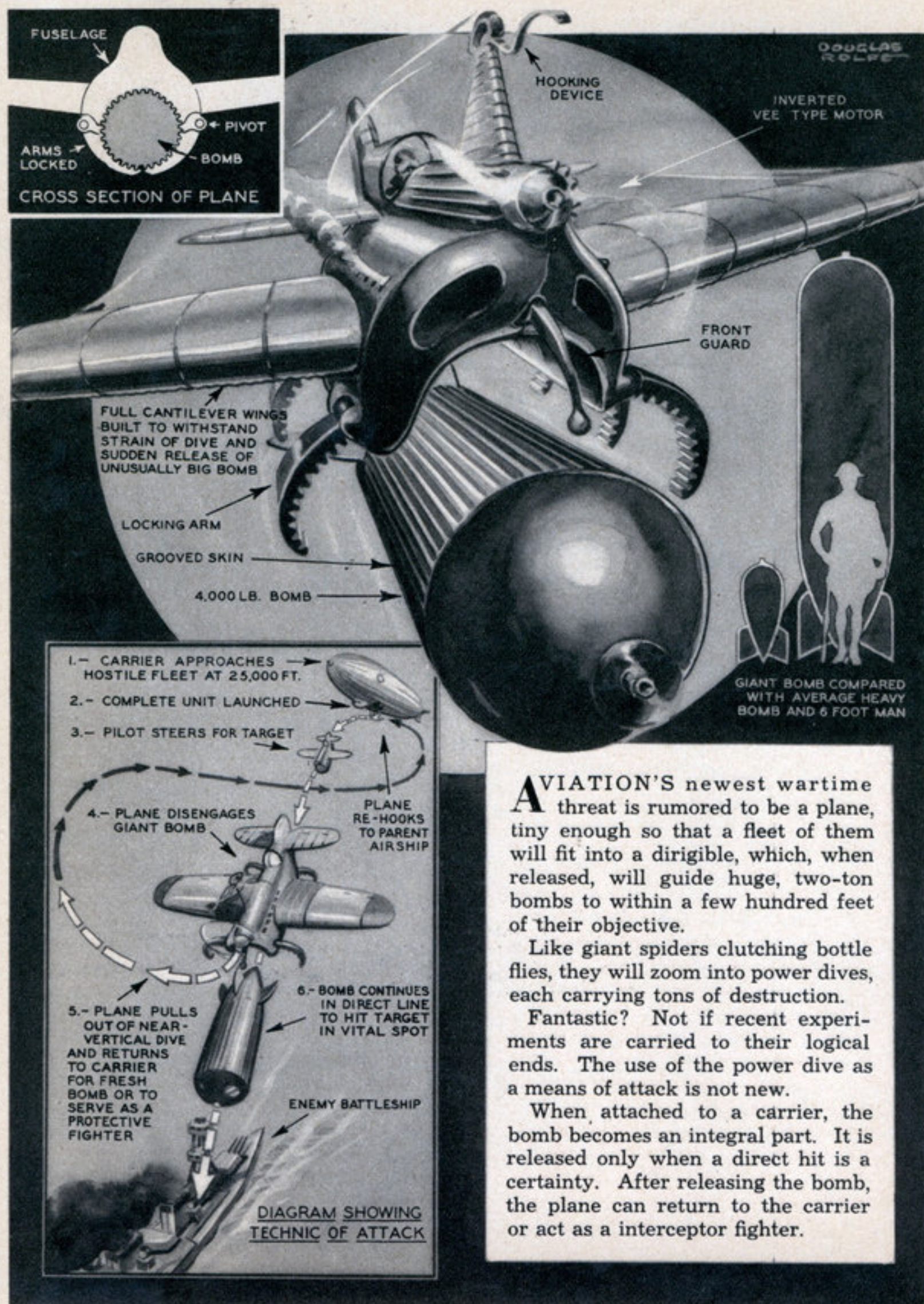


SEE PAGE 82

STEWART
ROUSE

BROADCASTING FROM A SUBMARINE

DIVING SPIDER PLANE TO HURL Big BOMB



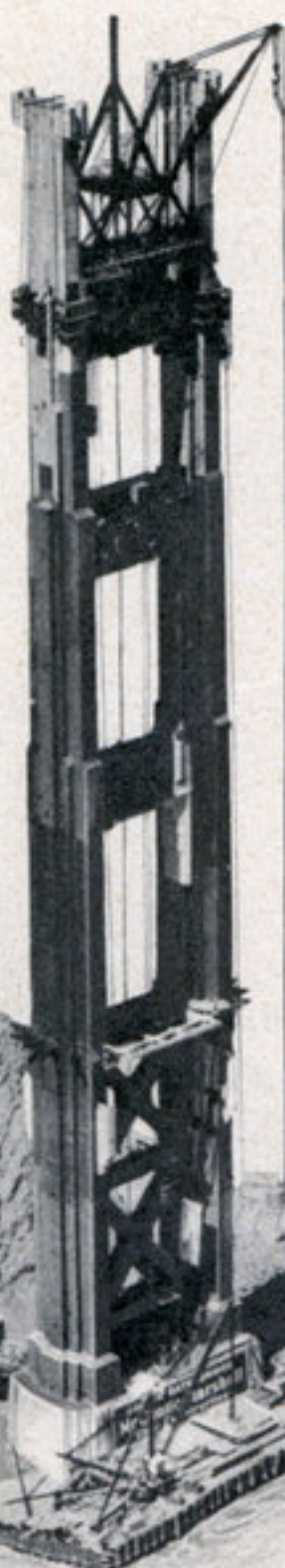
AVIATION'S newest wartime threat is rumored to be a plane, tiny enough so that a fleet of them will fit into a dirigible, which, when released, will guide huge, two-ton bombs to within a few hundred feet of their objective.

Like giant spiders clutching bottle flies, they will zoom into power dives, each carrying tons of destruction.

Fantastic? Not if recent experiments are carried to their logical ends. The use of the power dive as a means of attack is not new.

When attached to a carrier, the bomb becomes an integral part. It is released only when a direct hit is a certainty. After releasing the bomb, the plane can return to the carrier or act as a interceptor fighter.

World's Longest Bridges Span San Francisco Bay



The tower traveler at the top of the 746 foot Marin tower of the Golden Gate bridge. The traveler is equipped with two 80-ton derricks for handling heavy steel bridge girders.



HIGH over the surging tides of San Francisco's Golden Gate, the two towers of the world's largest single suspension bridge stand in defiant majesty as symbols of man's victory over natural forces. And farther back, the eight mile skeleton of towers and piers stretch across the San Francisco—Oakland bay, ready for the spans which will complete this, the world's most costly bridge project.

These bridges, built at a total cost of \$112,000,000, are being erected to aid traffic in and around San Francisco. The bridge to Oakland cuts the 30 mile trek around the circuitous shoreline of the bay to a straight $8\frac{1}{4}$ mile trip across the bridge; the Golden Gate project eliminates a detour of approximately 80 miles for direct coastal traffic between Canada and Mexico.

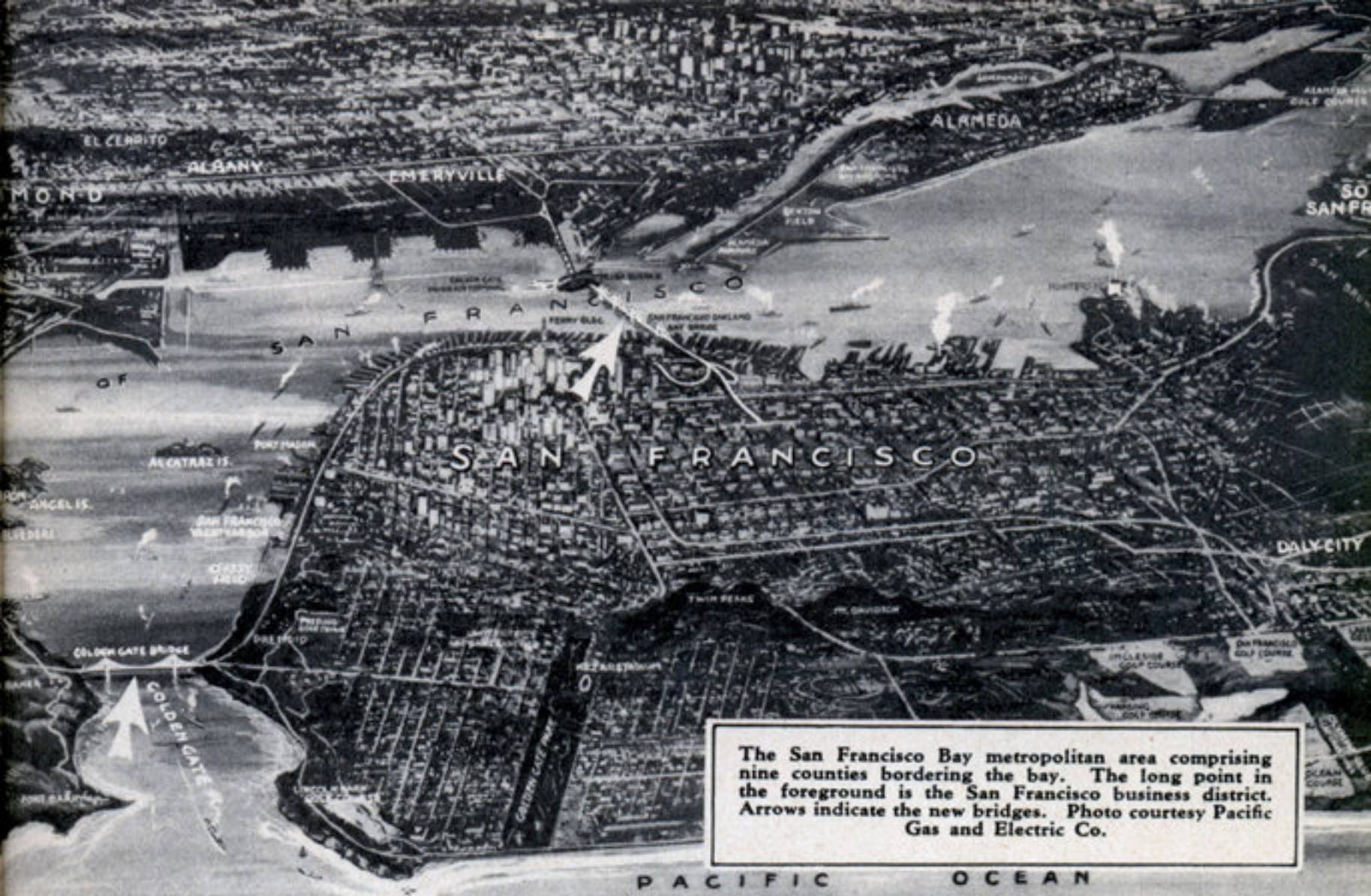
Since the beginning of the work on the two bridges, 18 construction records have fallen. Thirteen of these were broken in the building of the San Francisco-Oakland-bay bridge, declared by President Roosevelt to be the

RINCON HILL ANCHORAGE

PIER 519 FT. ABOVE WATER

WEST BAY ANCHORAGE 235 FT. ABOVE WATER

THE WORLD'S LONGEST BRIDGE—



largest construction project started in the United States in 1933, and rated by engineers as tenth among the structural wonders of the world.

Built at a cost of \$77,000,000, 6.7 per cent of the total steel produced in the United States in 1933 went into the construction of this gigantic project. It will support a double highway 235 feet over the bay 8¼ miles, from San Francisco to Yerba Buena Island and from Yerba Buena to the city of Oakland.

Fifty-one piers and three cable anchorages were required to make the crossing. Especially unique is the center anchorage in the middle of the West Bay which is designed to take strain from both sides as the common anchorage of two suspension spans. To resist this terrific pull, it is sunk 220 feet into the bed-rock and towers 235 feet above low water level. The anchorage is 197 feet long, 92 feet wide, and has an overall height of more than 500 feet.

The San Francisco anchorage on Rincon Hill is a gravity type cement cube, a huge

by CHARLES W. GEIGER

A comprehensive article on the Golden Gate and San Francisco Oakland Bay bridges, telling of man's struggle with nature to complete, at a tremendous cost, two of the most daring construction feats ever undertaken by American engineers.

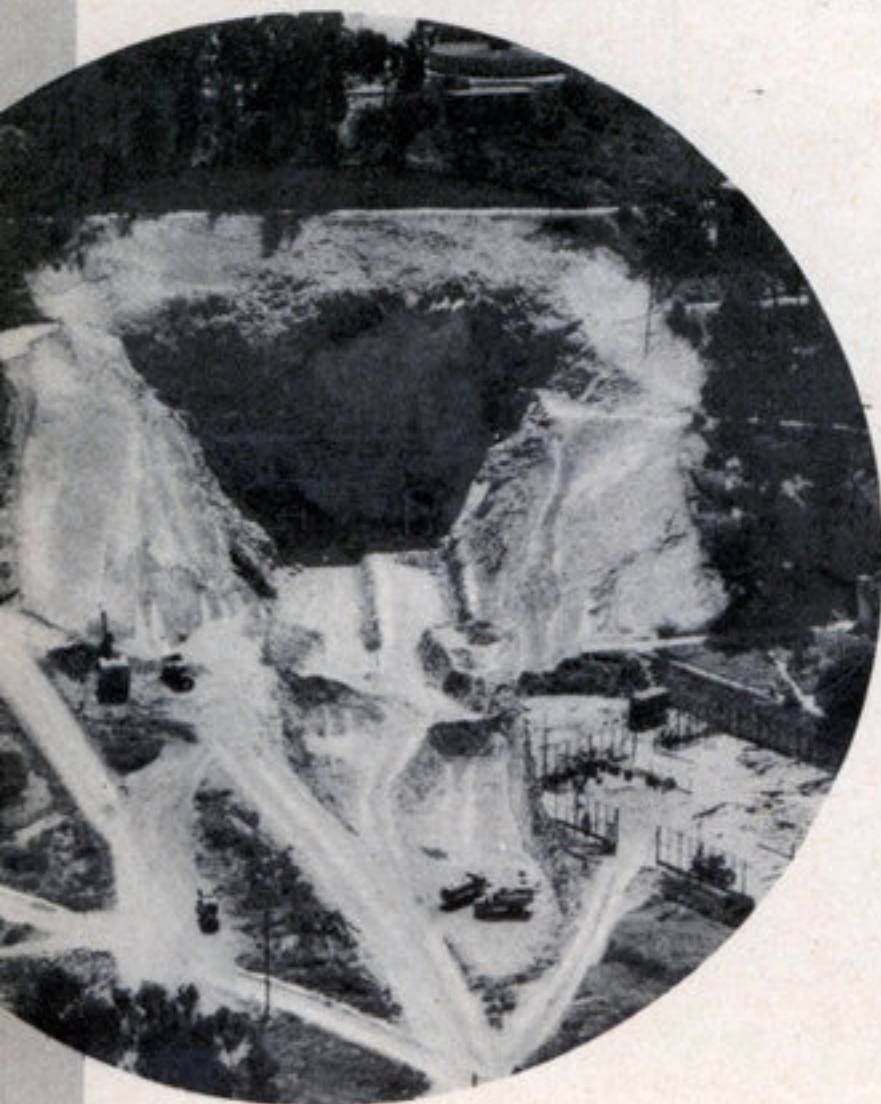
A view taken inside the oval fender showing the metal frame used for lowering the divers into the water and for removing him from the bottom to the surface. Divers were often compelled to work 100 feet under water surveying pier sites.



OAKLAND BRIDGE ROADWAY TUNNELS THROUGH



Above—Bridge workers handling a steel girder on the Oakland Bay bridge. San Francisco is seen in the background. Lower right—A cross section of the Oakland Bay bridge. Below—Beginning the construction of the world's largest vehicular tunnel on Yerba Buena Island. Photo courtesy Associated Oil Co.

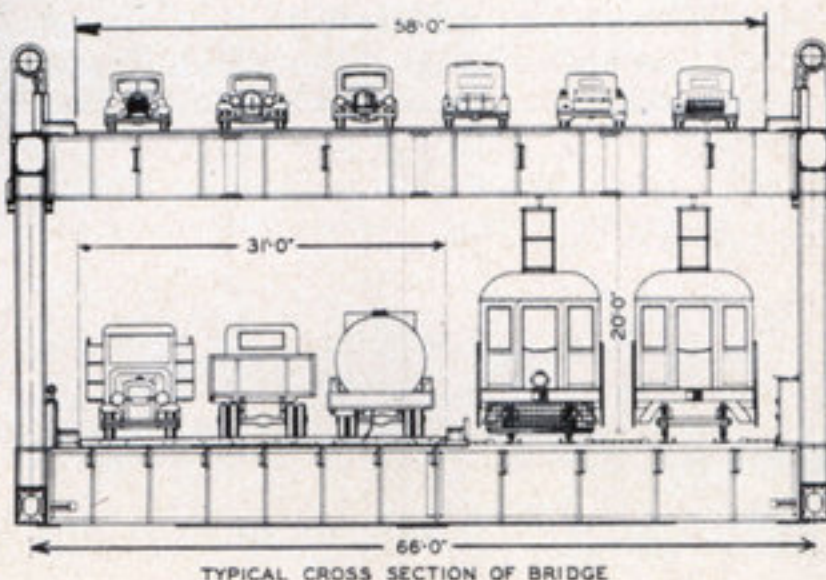


Records Of San Francisco Oakland Bay Bridge.

The world's most expensive bridge—cost, \$77,000,000.
The world's longest highway bridge—8 1/4 miles long.
Has the most piers of any bridge in the world with 54, three of which are anchorage piers.
It entailed the pouring of concrete 242 feet below water.
It required the sinking of a caisson 228 feet.
Excavation was carried on 242 feet under water.
It spans 9,000 feet of navigable water.
The project required the construction of the largest bore highway tunnel.
It has 70,800 miles of supporting cable.
It has two suspension bridges built in tandem.
It was the largest construction project started in the United States in 1933, using 6.7 per cent of the country's total steel output.

Records Set In Building The Golden Gate Bridge.

The first bridge to be built across the open sea.
The world's longest suspension type structure with a single span of 4,200 feet.
It has the highest bridge towers in the world—746 feet.
It has the greatest clearance, 220 feet above the water.



ROCKS AT YERBA BUENA

mass of masonry sunk deep into the earth; supported by its own weight, and rising 200 feet to the level of the bridge. The Yerba Buena anchorage will be accomplished by gouging two cable tunnels 160 feet into solid rock.

Four concrete and steel piers, rising from 474 to 519 feet above the water will support the cables from which the spans of the two-mile double bridge will be suspended.

The use of Yerba Buena Island as a mid-anchorage necessitated the cutting of a 540 foot vehicular tunnel to connect the two sections of the bridge. Seventy-eight feet high and 67 feet wide, double decked and steel-lined, it is the longest tunnel of its kind in the world.

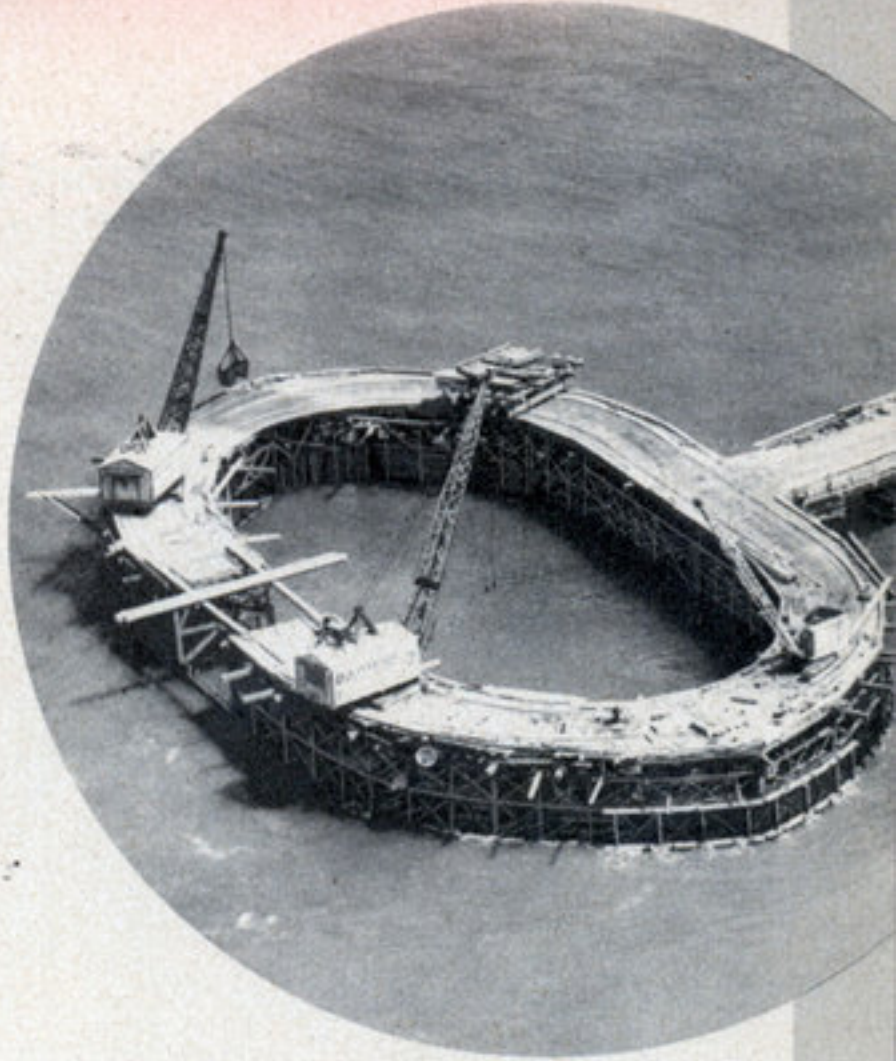
The East Bay crossing between Yerba Buena Island and Oakland will consist of a cantilever span 1,400 feet long with two 510 foot anchor arms, five simple spans each 500 feet long, and 14 truss spans each 290 feet long.

The bridge structure, at its easterly end, terminates two miles from shore in the shallow water and tide flats of the East Bay. Here it is joined by a four-mile fill highway extending to shore at Oakland and then swinging north over the tide flats to Berkeley. The construction of this highway requires one-half million cubic feet of sand fill and 348,000 tons of protecting rocks.

The bridge comes into San Francisco 175 feet over the harbor, so high above sea level that the Palace Hotel of San Francisco could easily be slipped underneath. The lower deck of the bridge, used for heavy trucks and interurban cars, first touches ground on precipitous Rincon Hill; the top deck reaches ground 4,200 feet to the westward. Curved ramps swing from the top deck at Rincon Hill for motorists bound in diverse directions.

The construction of pier E3, adjacent to Yerba Buena Island is a feat that will go down in the annals of engineering history.

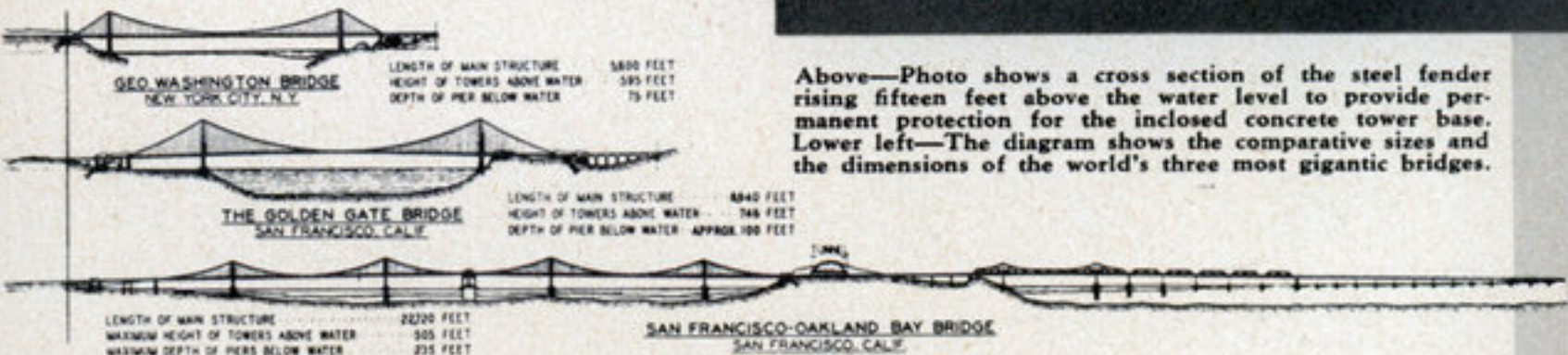
[Continued on page 141]



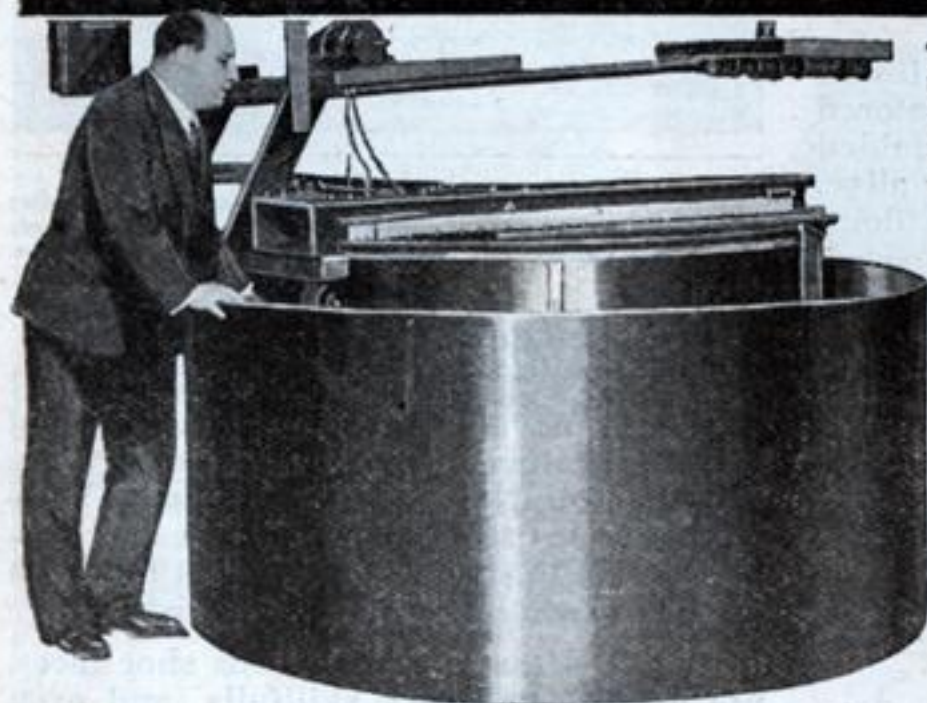
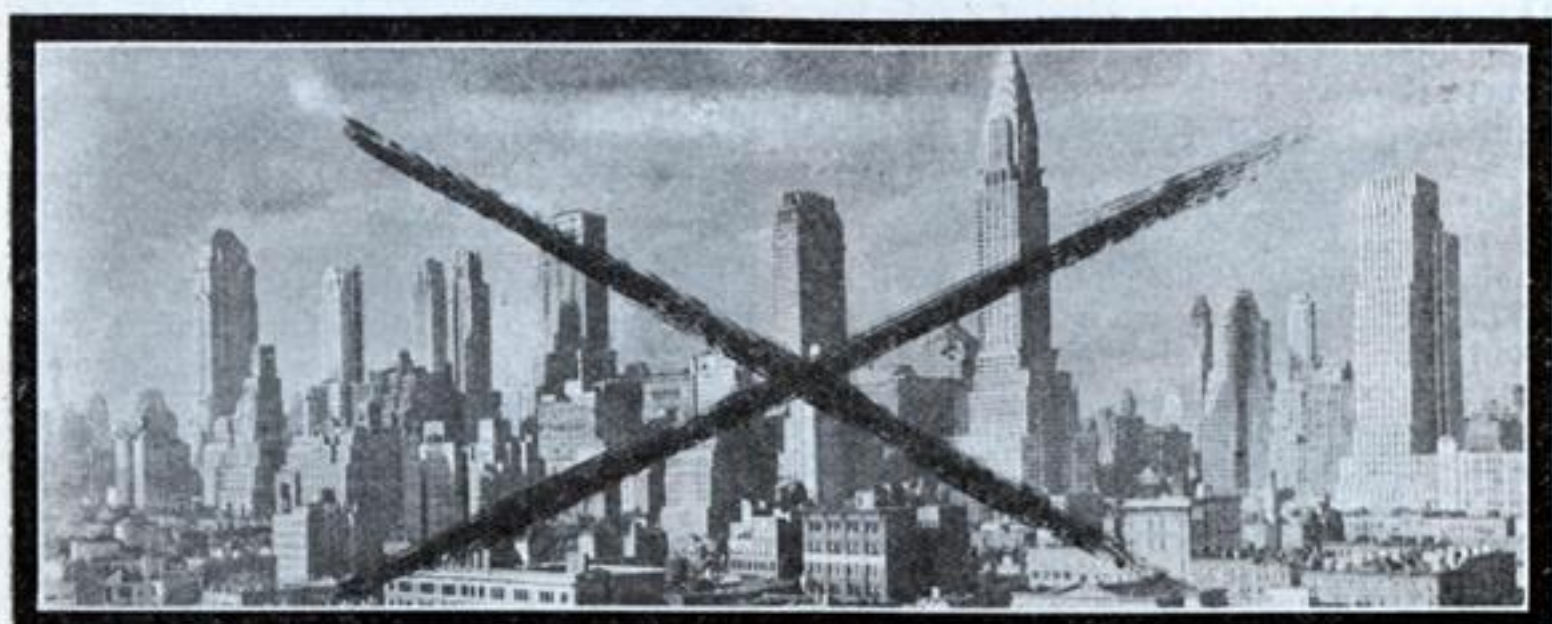
Above—A view of the oval fender of steel construction built to facilitate the pouring of the cement piers. A cement seal inside the steel permitted the water to be pumped out to provide a dry working area one hundred feet below the surface of the water. Photo courtesy Associated Oil Co.



Above—Photo shows a cross section of the steel fender rising fifteen feet above the water level to provide permanent protection for the inclosed concrete tower base. Lower left—The diagram shows the comparative sizes and the dimensions of the world's three most gigantic bridges.



SKYSCRAPERS DOOMED



The doom of Manhattan's towering skyline, above, may be sounded by the centrifuge, left, below. Construction models placed in this machine are whirled about until centrifugal force equals the pressure to which the full-size buildings are subjected by earth in actual sub-surface conditions.

by WILLIAM JENNINGS

SAFE from bomb attacks—free from disease and changing temperatures—living in cities a mile beneath the surface of the earth—such is the dream of science for the man of the future, a not impractical dream which may doom the towers of Manhattan and every other large city to destruction.

Despite its towering skyline, the trend of building construction in New York City has been ever downward. Today the island of Manhattan and its surroundings are honeycombed with a vast network of underground facilities. There are more than 130 tunnels and underground areas in the metropolitan district; more than 2800 miles in the subterranean sewage system, and about 600 miles of subway trackage carrying 5,000,000 passengers every day.

With habitable space growing more scarce every year in the crowded centers, architects and scientists freely predict that vertical cities, built from the earth's sur-

face downward, may eventually supplant the skyscrapers of today.

The reasons for their belief in the practicability of such a plan lies in the recent successful tests of a machine known as the "centrifuge" invented by Professor Philip B. Bucky, of Columbia university.

Explained in its most simple terms, Professor Bucky's machine is a device into which accurate scale models of underground structures may be placed and whirled about in such a way that the centrifugal force equals the actual earth stress to which full sized construction would be subjected.

Built of the same materials as the structure to be tested, the model is placed on the centrifuge and whirled at speeds up to 4000 revolutions a minute until the centrifugal force tends to pull the model apart.

A movie camera simultaneously records each revolution of the machine. When the film is run off on the screen it shows up the stress and strain under varying degrees of force up to the collapse of the model.

Heralds New Building Era

From these technical tests a new science of foundation engineering is expected to develop. Lack of a yardstick with which to measure the stresses of the earth has hitherto kept architects from planning extensive underground projects.

Testing depths up to 6000 feet, the centrifuge opens up an amazing vista of life in the future. It will be possible to have business blocks under airports with the

by UNDERGROUND CITIES?

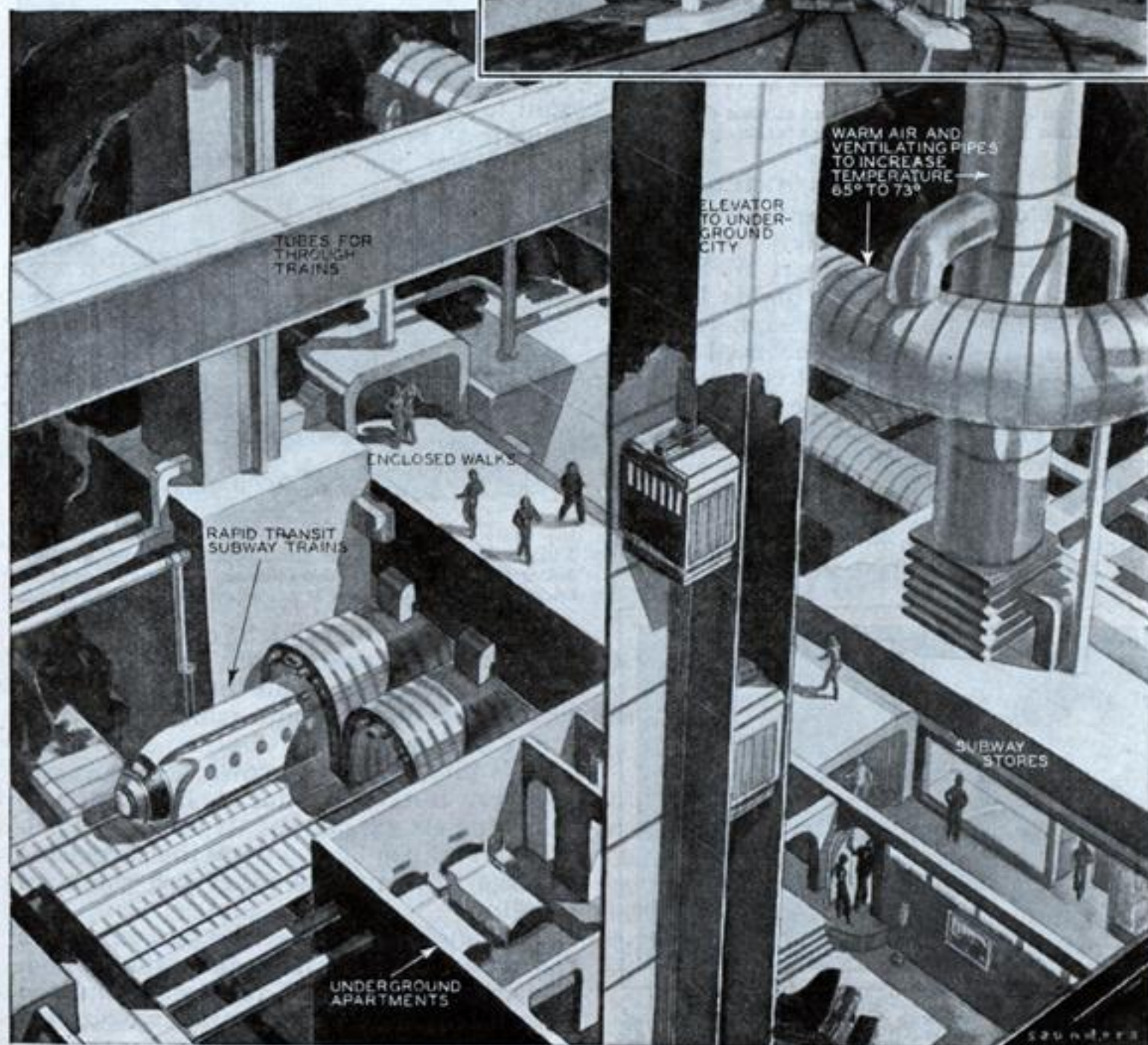
surface left clear for planes. Vast subterranean caverns could be constructed, capable of sheltering entire populations against enemy bomb attacks. Office buildings, factories, homes and theaters—all could be sunk into bedrock.

Life underground would be different only in the respect that conditions, under scientific control, would be more sanitary and healthful. Conditioned air would prevail and the sun's absence compensated for by

the use of ultra-violet lamps. The temperature would be constant at about 62 degrees. Coal bills would no longer worry the householder and bacteria would be killed.

Professor Bucky does not venture to make extravagant predictions. His centrifuge does not construct; it merely tests. The advantage of the machine lies in the fact that the safety of underground buildings may be absolutely proven by testing miniature models.

Photo at right shows one of the three-tube subway tunnels, part of the vast network underlying New York City. This picture is a possible forerunner of the future underground city shown below. Note elevator shafts which will carry city cave dwellers from one level to another, the giant air conditioning tubes and the enclosed roadway, leading from left to right, for through traffic. Lower part of drawing shows an underground apartment fronting on a street lined with stores and shops furnishing all necessities.



EDITOR'S PAGE

Flat-tube color TV is news in anybody's book. But when it hits first production in a miniature portable you can tote anywhere—with a rectangular screen carrying the same image on both sides of the set—it's a phenomenon. That's why, when our electronics editor, Larry Steckler, began getting signals about it on his alert antennae, we didn't spare the horses. The result is our exclusive cover story on page 90—a genuine first report on one of the most dramatic electronic developments for you in a long, long time. To make the earliest possible issue, we built a fire under our West Coast editor, Tom Stimson. Tom made arrangements for our art director, Ray Schulze, to stage the spectacular cover on this issue. They rented some beach and hired a lovely young model named Bobbie Whitby (below). Larry and Ray flew to the Coast on a few hours' notice. While Larry served up the story with the developers of the set, Ray, Tom and photographer Bob Smith were shooting the cover pictures. There's nothing new about flat TV tubes. The military has been using them in aircraft for some time. But, until now, they've been prohibitively expensive. This new consumer breakthrough may be the forerunner of a whole new world of TV—that can be mounted in picture frames on the wall.



Photographers don't always use their heads, as any editor will tell you. The picture at right, above, might seem—at face value, if you'll pardon the expression—to

prove it. The visible nether regions belong to PM's staff photographer, Gene Colangelo. It was snapped by Bob Berger, unknown to "Gino" who was busy shooting some fancy angles for an upcoming automotive feature. But appearances can be deceiving. Gino *always* uses his head, as he is quick to admit. We have to admit it,

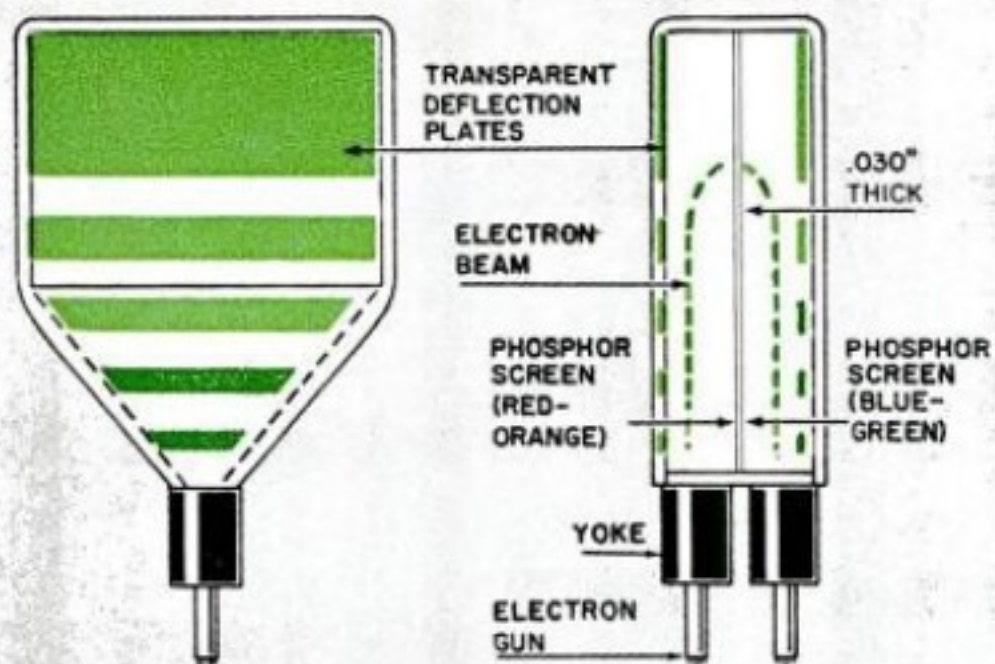


too. There have been times when he's used not only his head, but everything he's got. He's been soaked to the skin in muddy water, trying to get close-ups of cars coming through the trough on test tracks; he's survived roll-overs in cars that were being limit-tested; he's teetered on skyscraper perches to achieve exciting angles on run-of-the-mill subjects. In the case of this picture, Gino was using his coat to shade his reflex camera. The head was there, all right. Figuring angles. All kinds.

Exploding cigars and itching powder once comprised the pinnacle of cornball practical jokes. It is a relief to know that such cloddish buffoonery is now as square as the fox-trot. Today, *geniuses* are at work in the practical joke department, and the results are not only fascinating—they're hair-raising. Consider the Caltech whiz kids who glued a classmate's furniture upside down, with epoxy, on the ceiling. The way-out stunts of modern day practical jokers, are included in *Genius at Play* in next month's PM.



Fantastic new portable color tv set has flat picture tube you can watch from both sides. New flat-tube development is first step toward practical hang-on-the-wall television for your living room. BY Larry Steckler



THINNEST COLOR picture tube gives up its secrets in detailed PM sketches

FLAT TV PICTURE TUBES ARE REALLY HERE. There are both color and black-and-white versions. I know. I've seen them in action. I've held them in my hands. And you'll soon be seeing them in a new breed of portable TVs sporting a famous maker's label around the end of this year.

Now settle back and we'll let you in on the news. Out in the suburbs of Los Angeles are the business offices of the Intertel Corp. And inside these offices some remarkable things have been going on. They've developed a flat color-picture tube like the one diagramed above. It has a 6-inch screen that gives a perfectly rectangular viewing area, $4\frac{3}{4} \times 3\frac{1}{2}$ inches. Best of all it's a tiny $2\frac{3}{8}$ inches thick. When combined with a transistor color TV chassis it makes a color set that's a mere $10 \times 6 \times 3\frac{1}{2}$ inches, weighs six pounds and costs about \$200. Just the right size to take along on your next trip. They've come up with a monochrome (black-and-white) portable too, and it's even smaller— $9 \times 4\frac{1}{2} \times 2\frac{1}{4}$ inches—and costs \$150.

While only small-screen versions of the flat picture tubes have been built so far, there is no limit to the size tube that



can be built. Scaling-up, a 23-inch rectangular tube would be about 4 inches thick. You could certainly hang it on your living room wall and probably will.

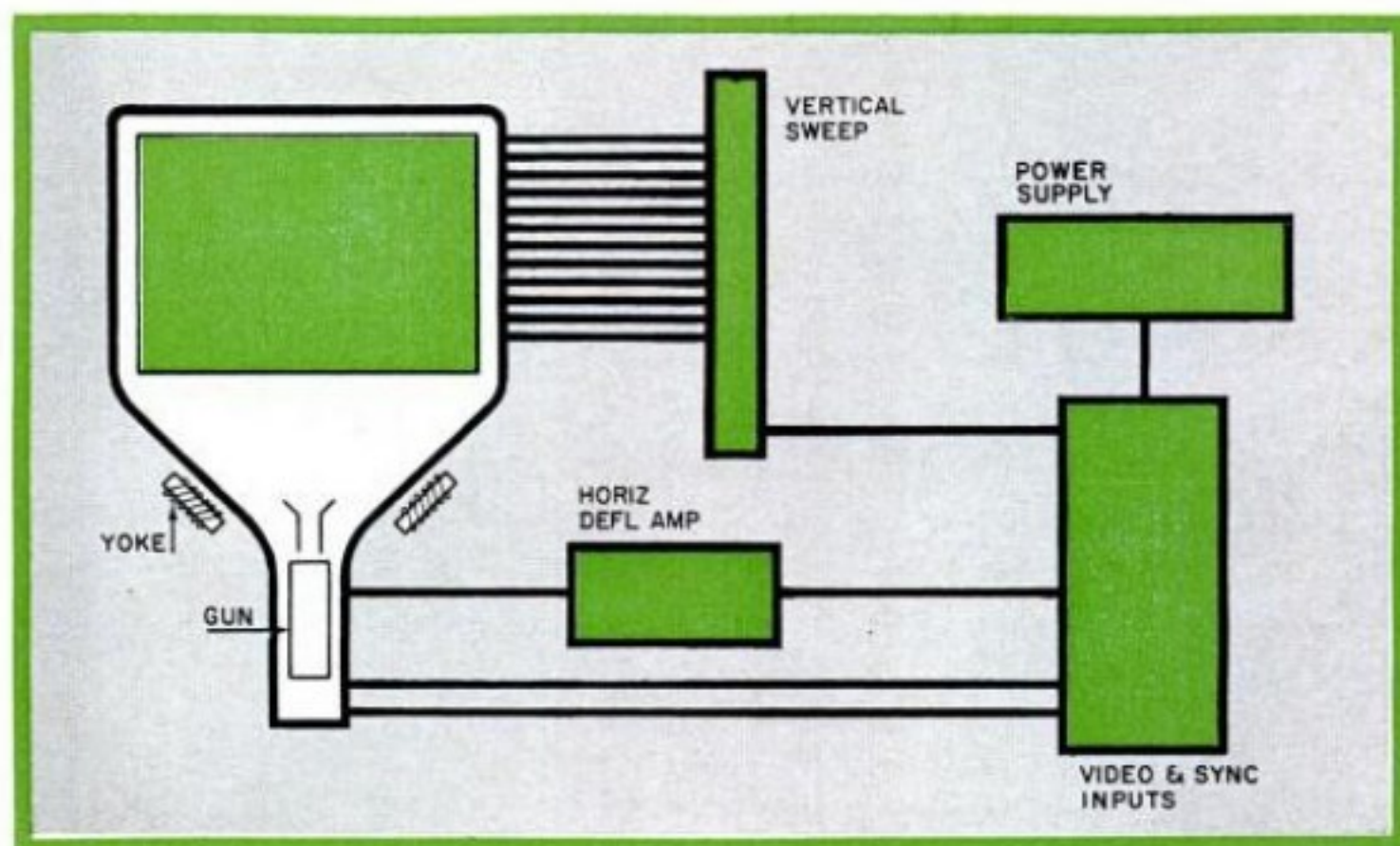
The Intertel sets are unique in several ways other than their use of the flat tube. To me, the most fascinating feature of all is that the picture can be viewed from either side of the tube. Of course, it appears in reverse on the back side, but it's a great way of making a small-screen portable viewable by a greater number of people.

Early models of the set will be viewable only from the front as the space behind the picture tube will be taken up by some electronic circuitry. Later versions may include the two-sided viewing if the public demands it. I think it will. The cabinet will be enlarged slightly to make room for the wiring that would otherwise block off the rear of the tube.

The color tube is unique in itself. It is a two-color tube that uses two electron guns and two phosphor screens instead of the three-gun system now accepted as the standard. It does this by combining the colors (red orange and blue green), following a specially developed additive system inside the tube, to give full color reproduction. Actually, at least to my eye, there are some discrepancies in the color reproduction. The two-color flat tube cannot deliver a true purple or a dark, intense blue. But flesh tones are more real than anything I've seen before and if these tones are right I doubt if you'll even know that the female singing star is wearing a purple dress and not the reddish-blue one you see.

Even more important is that the two-color tube gives a considerably brighter picture than the conventional color tube. This is vital to a portable TV that will be used outdoors every so often. The picture on a standard color set can barely stand up against normal room lighting. Outdoors it would be completely washed out and impossible to view.

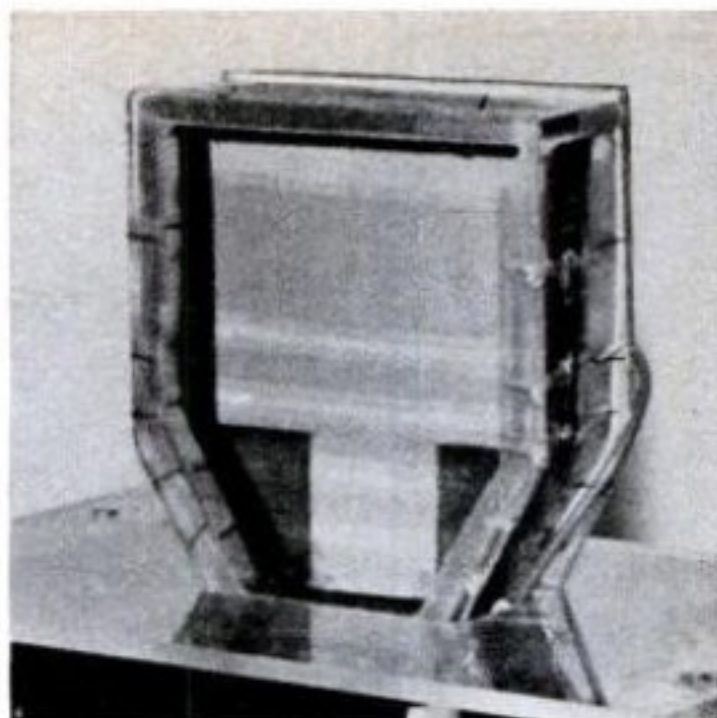
Since the flat tube is quite different from conventional picture tubes, it works a bit differently too. Look at the diagram at the top of page 91. You'll note that



SCANNING CIRCUITS ARE DIFFERENT. Block diagram shows the basic arrangement of horizontal and vertical sweep circuits required by the new flat tube. Each corner of the screen is perfectly square



MONOCHROME TUBE IN ACTION. Mirror behind tube lets you see image on the rear. It appears right side up as mirror inverts reverse picture



FLAT COLOR TUBE is two monochrome tubes back-to-back. Dual phosphor screen is in middle. Electron beams are directed to it from both faces



INVENTOR WITH HIS BRAINCHILD. Leo Shanafelt, top-notch engineer behind the flat tube, works at his laboratory bench where he has the monochrome tube set up for another round of experiments

there are two electron guns at the bottom of the tube: one for each of the two phosphor screens. These screens are deposited on opposite surfaces of a thin (.030-inch) sheet of glass.

This dual screen is firmly fastened in the exact center of the tube. The electron guns fire a beam of electrons straight up behind the screen from either side. The yoke around the neck of the tube deflects the beam from side to side. The transparent deflection stripes on each face of the tube, directed by signals from the set's deflection circuits, deflect the beams against their respective phosphors to produce a picture.

The monochrome tube is a bit simpler as it has only one electron gun and one set of deflection stripes. On the crude handmade tubes I watched, these stripes are just barely visible as slightly darker portions of the screen while a picture is being viewed. In production versions of the tube these stripes should be completely invisible.

The advantages of a flat tube are many and varied. Some are quite obvious;



some not quite so apparent. Here are the most important ones:

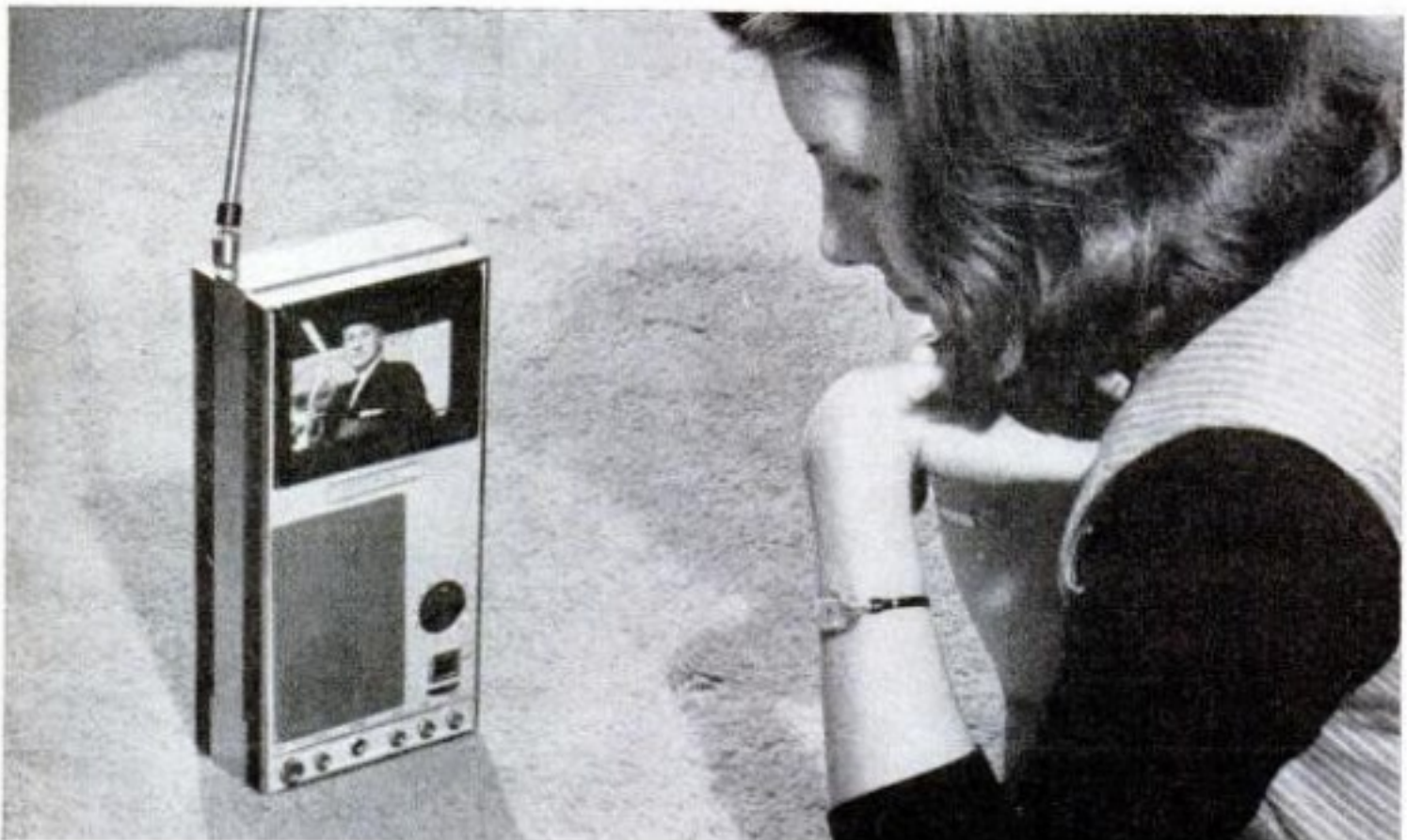
- Flat-tube sets are extremely thin, especially when compared to present-day models. They are easier to fit into a crowded room and do not take up floor space.
- Smaller, more compact TVs are possible. This means greater portability, lighter weight.
- Picture tubes are less complex. Specially blown glass envelopes are no longer needed. Ordinary plate-glass screens are easy to make.
- Two-sided viewing can be provided, if desired.
- Truly miniature, book and pocket-size sets become feasible. You may be looking for one soon.

Now let's look at a tiny flat-tube portable and see what we can do with it. Like a transistor radio, it can go anywhere. It's light and extremely portable. You can pass it to the kids to keep them occupied during long auto trips. You can take it with you to the beach or take it along on your winter ski tours. Or, for that special-occasion telecast you would give anything to see, bring it with you to your job—if you have an understanding boss.

In your home, large-screen sets will be built into the walls; they can be that thin. Those who like to watch TV in bed will be able to fit a set into the ceiling. Exotic styling for tabletop sets will become standard and remote controls for operating the set from your seat will be a must.

Other changes in set design resulting from the flat tube, as well as innovations in the tube itself, are bound to outreach my imagination. I'm sure that one day we'll have wall-sized screens made out of a flexible luminescent material that we can roll up out of sight when not in use. We may even end up with three-dimensional color TV.

But no matter which direction TV may take in the future, the industry is—right now—accomplishing a major breakthrough. The set manufacturers have been given a new ball to play with and I, for one, intend to keep tabs on what they do with it. ★★★



HER FIRST CLOSE-UP GLIMPSE of a flat TV portable in action utterly fascinates pretty PM secretary Millie Pedersen. Now, all she wants to know is how soon she can get one and how much it will cost

Fantastic party carts you can build

Tempest|Plymouth test—to the screeching limit

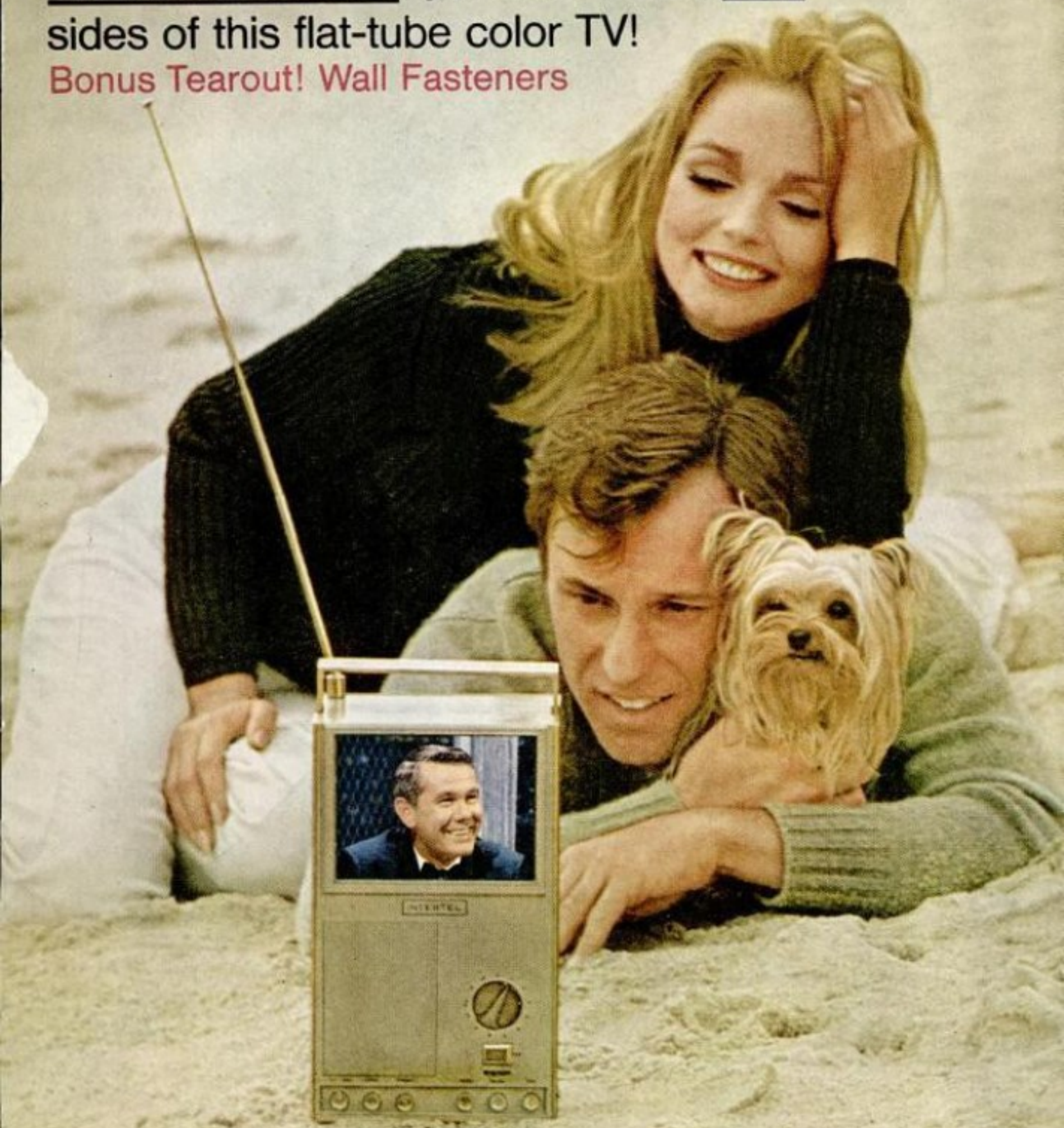
POPULAR MECHANICS

FEB. 1966

35 CENTS

BREAKTHROUGH: you can watch both
sides of this flat-tube color TV!

Bonus Tearout! Wall Fasteners



HOW SPACE DETECTIVES RATE RUSSIA'S MOON PROBES

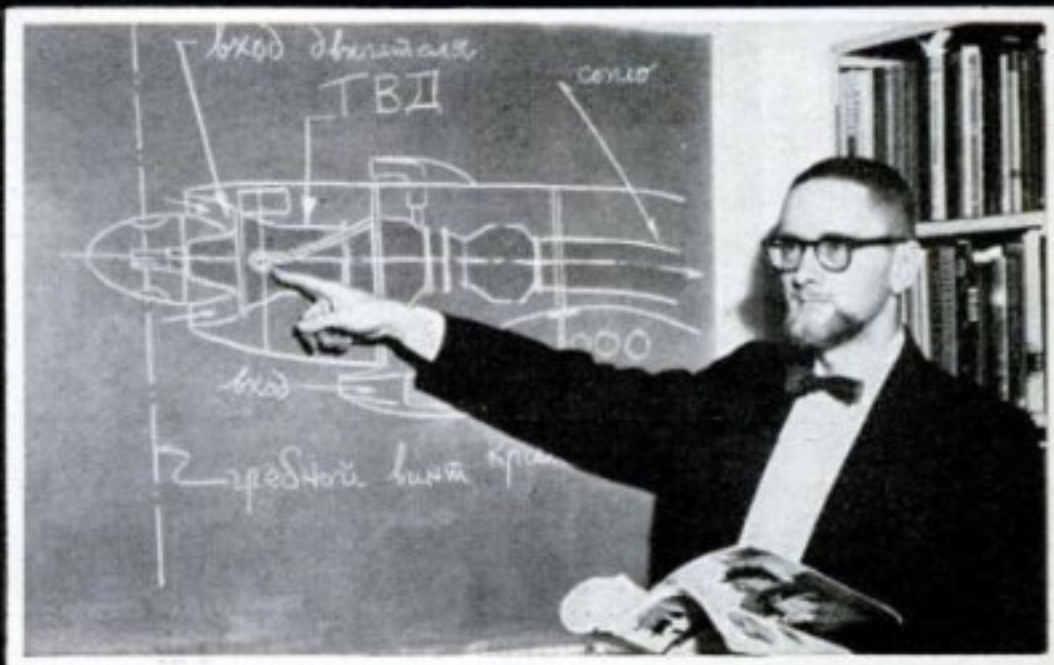
By S. David Pursglove

WHAT DO AMERICAN EXPERTS KNOW about the super-secret Russian space program? How soon will the Soviets land a space vehicle on the moon?

Thanks to a dedicated group of U.S. "space detectives," who work on their own time, we know a great deal more than the Russians would like us to know. Here are a few revealing facts about Soviet space vehicles these men have deduced:

- A Russian space ship fires 550 pounds of solid propellant to slow itself for re-entry into the earth's atmosphere.
- A parachute 59 feet in diameter lowers the manned spacecraft to the ground at just under 30 feet per second.

Led by physicist Donald J. Ritchie, a group of "space detectives" use computers and scientific savvy to crack the secrets of Soviet space capabilities. From bits and pieces of information, they've created composites of possible Russian moon probe vehicles, above, which are described in this article.



- The space vehicles, called Vostoks, land on a target 500 miles in diameter, usually near the center.

- When the Russians launch one of their manned satellites, they have a 43-percent chance of getting it into a perfect orbit.

- The Russians can use their existing launching rockets to send a man around the moon and back by sending just seven Vostok-size pay loads into an earth orbit and there building the moon rocket. To land on the moon and return, 33 launches would be needed.

The Russians have not handed us these facts—at least not directly or willingly. Our space sleuths have had to dig them out, piece by piece. Thanks to them, we now know what the Vostoks and other satellites and weapons look like, how they are built, how they perform and what the Russians are likely to do with them next.

The space detectives are reputable scientists who for nearly a decade have been dissecting the Russian space and missile program. They don't do this work for the government or for industry. They want the freedom to discuss their results openly.

These men piece together bits of information dropped at international meetings and screen out planted misinformation. They analyze contradictory statements in Soviet publications. They evaluate each new Russian space feat. Sometimes they spot new satellites, parts of rockets or shadowy hints of missiles in photographs.

Often, the space detectives work only with the slim data that tracking stations are able to collect on satellite flights. Sometimes, pure mathematical analysis can confirm conclusions drawn from photos. And later photographic evidence is a double check on the data cranked slowly,

item by item, from electronic computers.

One space sleuth who uses all these methods is Donald J. Ritchie. At the Bendix Corporation's Southfield, Mich., Research Laboratories Division, mathematician-physicist Ritchie is the assistant department head of the new Technology Department. His official duties run the spectrum from radiation weapons to arms control programs. But he is not paid to analyze Vostoks. He does that on his own.

Shortly after the first manned satellite, Vostok 1, orbited on April 12, 1961, Ritchie met with three Southfield colleagues: R. W. Duncan, G. A. Cornell and W. H. Gruber.

"Let's analyze the Vostok," he suggested. "Let's see what makes it tick."

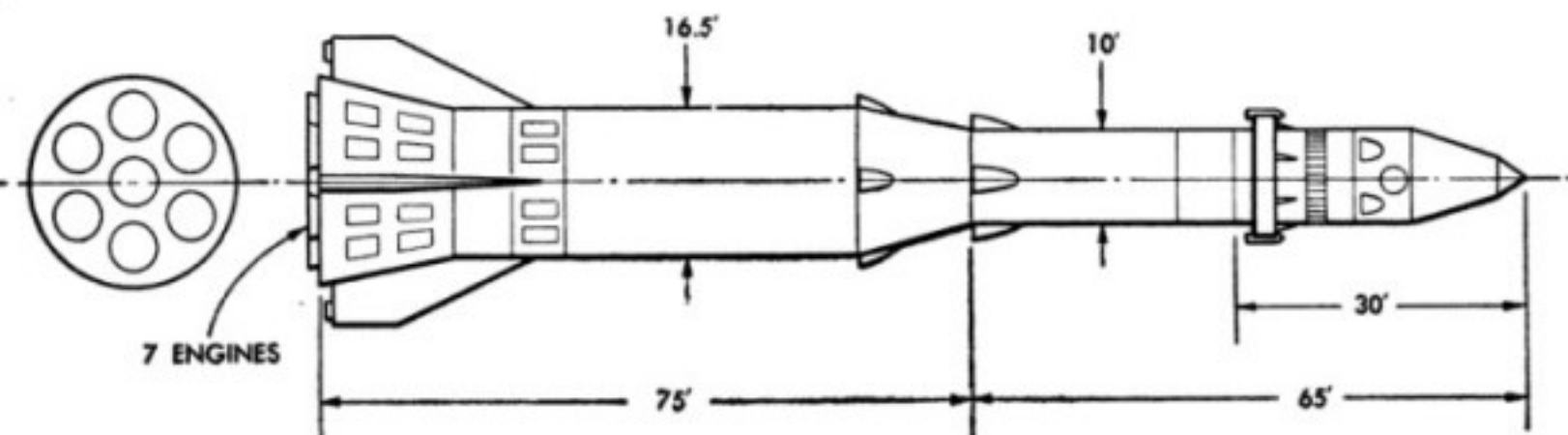
"How?" he was asked. "Where do we start? We don't know anything about it."

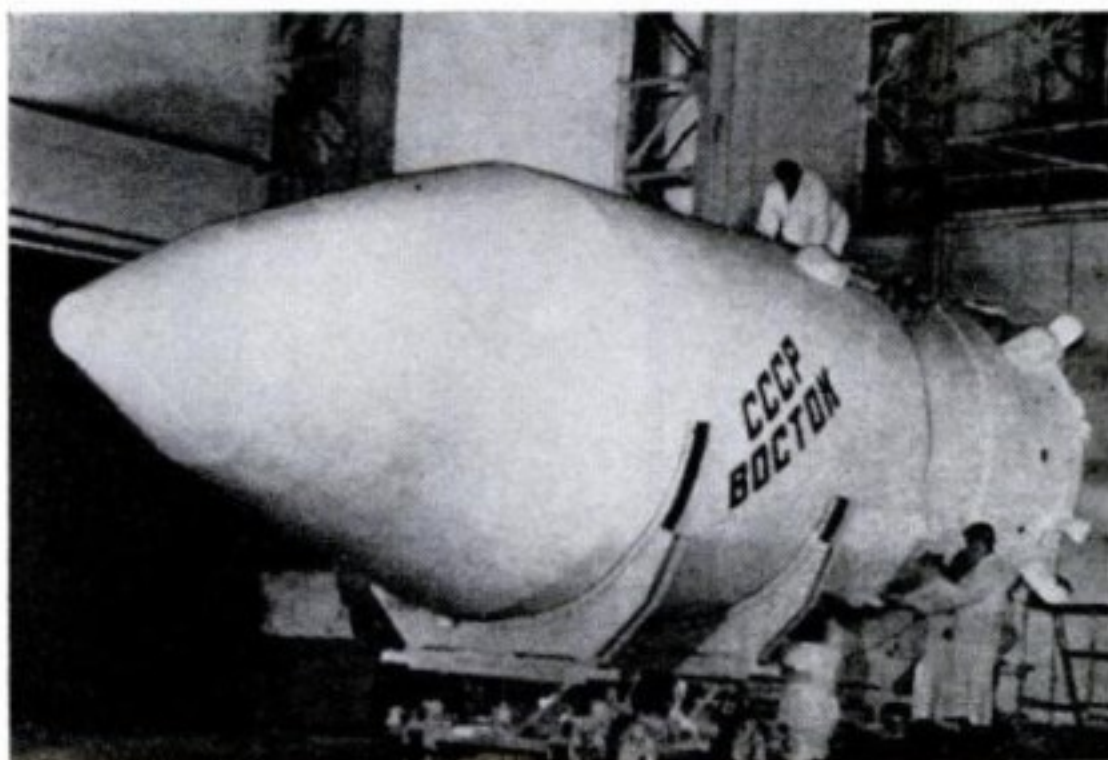
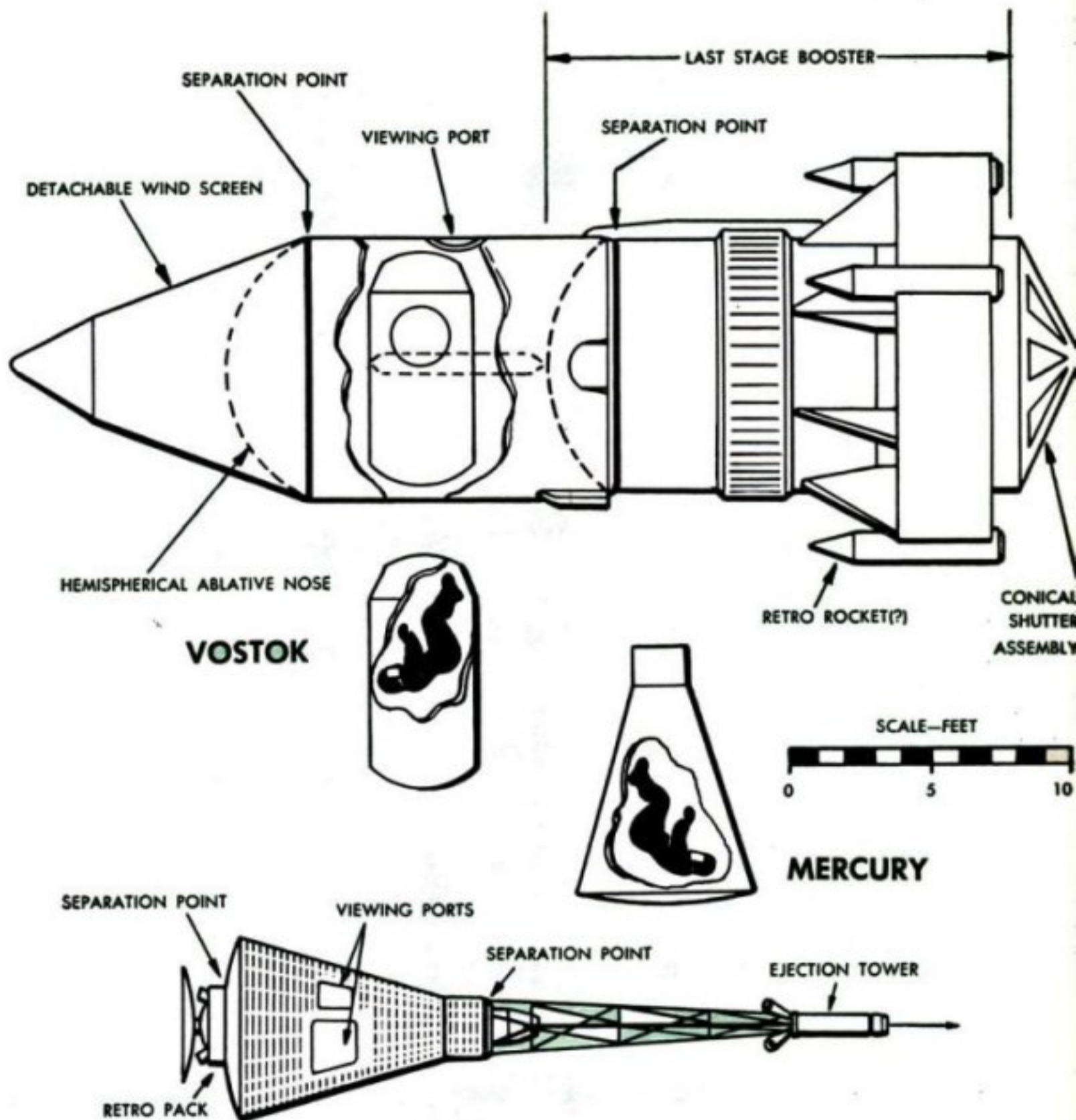
The Art of Space Detecting

"We know enough for a start," Ritchie pointed out. "We have the perigee. We have the apogee. We have the take-off time. We know where it was in orbit at all times and we have the landing time. Those facts have to fit laws of nature that are the same for Russia as they are for the U.S. With a computer analysis, we should even be able to draw a picture of what a Vostok looks like." The others grinned. Why not?

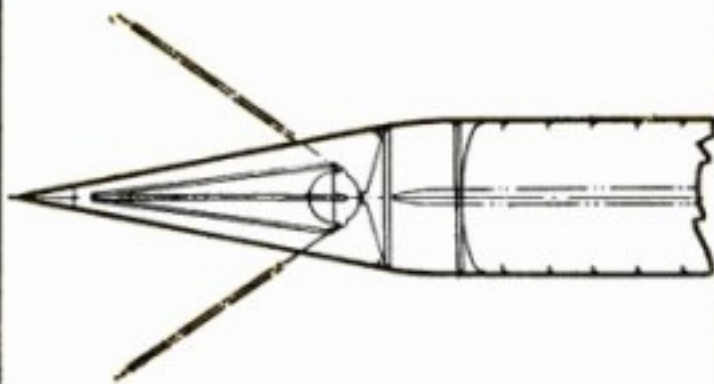
They started by plotting Vostok's exact orbit. They knew that high point (apogee) was 203 miles, its low point (perigee) 112.4 miles. Calculations based on the earth's radius (approximately 4000 miles), showed that the orbit was nearly a perfect circle. The slight difference between the actual orbit, and what Ritchie assumed to be the goal, a perfect circle, later helped him to determine the launching accuracy

VOSTOK 2 with its rocket booster probably looks much like this drawing by Ritchie; engineering and mathematical calculations gave him its dimensions

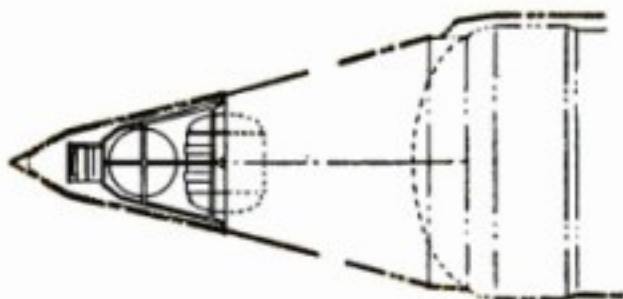




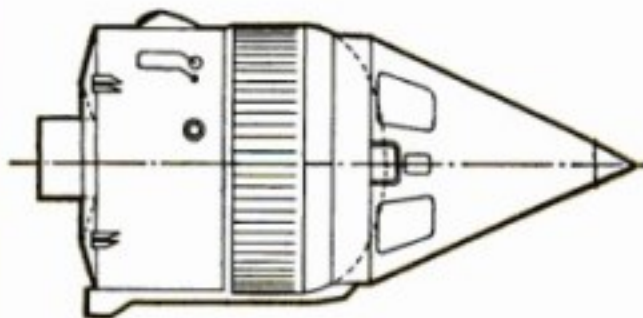
THE VOSTOKS (left, and top drawing above) are much bigger and heavier than Mercury components (bottom drawing) but their pilot capsules are roughly the same size. The sides of the Mercury cabin (at right in center of drawing) slope inward to avoid heat during re-entry



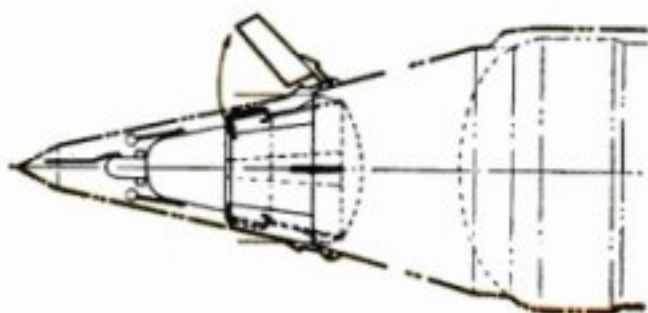
SPUTNIK I capsule went up in the nose of a T-1 rocket on October 4, 1957. Drawings of Red capsules were made by Don Ritchie



SPUTNIK II carried the first space traveler, a dog. Capsule dimensions were carefully calculated from scanty data available



LUNIK III, a model of which was exhibited in 1959, gave Ritchie clues to Vostok II dimensions; photos confirmed findings



SPUTNIK III has what appears to be an opening for catapulting an ejection seat. Drawings are one-fortieth of full scale

of Russia's big liquid fuel booster rocket.

Knowing the orbit, the mathematicians were able to calculate the exact speed and angle at which the Vostok was injected into its flight path.

With these facts established, the men turned their attention to re-entry. Engineering data told them that such a vehicle would have to enter the atmosphere at about a 3.5 degree angle to the "top" of the atmosphere, some 60 miles above sea level. A sharper re-entry angle would cause the craft to enter the dense air too rapidly and burn up; a lesser angle would cause Vostok to "skip off the roof" of the atmosphere and sail out into space.

To hit this angle, the retro-rockets would have to slow the ship at a rate of at least 440, and not more than 733 feet per second. A safe deceleration rate seemed to be about 587 feet per second. This helped in estimating thrust of the braking retro-rockets and the length of time they acted.

The estimates were plugged into equations and fed into a computer. The results were compared with the nearest set of figures that any rocketry engineer would try to achieve for the known conditions. The differences told the mathematicians just how accurate the braking system is (within five percent).

Another error analysis showed that timing of the signal to de-orbit was not critical. A 17-second error would mean only an 81-mile shift in the recovery zone on the ground. The retro-rocket propellant, apparently, is a fairly standard product; thus, 553 pounds of it firing for exactly three seconds would put Vostok into its proper re-entry trajectory.

An analysis of the trajectory showed that the ship uses a single application of

EJECTION SEATS, which space sleuths spotted in pictures of the Vostok, won't be used in U. S. space vehicles until Project Gemini becomes operational



braking power; the braking thrust is not applied in spurts. This indicates that solid propellants are probably used for braking Vostok; a start-stop-start system generally uses a liquid propellant.

The deceleration figures also revealed the G-forces acting on the cosmonaut's body. These were high enough to confirm the earlier supposition that the pilot lies on his back in a cabin that has to be turned around between blast-off and re-entry.

It was fairly simple to calculate a heating profile from the trajectory and make an educated guess as to the structural materials. The profile showed that Vostok probably has very little internal cooling. This means that most of the re-entry heat probably is absorbed by an ablative material and the kind of shock wave that is created by a blunt shield rather than a pointed nose. This is the way it's done with Mercury capsules, but with a major difference that was discovered later.

How was Vostok eased to a landing after entering the atmosphere? Complete re-entry required about 30 minutes for a ship of its known weight, velocity and trajectory. Safety considerations place a 30-foot per-second limit on the speed at which such a vessel could hit the ground. The scientists figured that recovery should begin at about 23,000 feet altitude; a parachute 2750 square feet in area, or 59 feet in diameter, would do the trick.

Before they had finished with Vostok, the space sleuths not only knew how the spaceship operated; they also knew all the ways in which it might fail to operate, and what would happen in the event of various errors. An error in re-entry speed of not more than 25 feet per second, Ritchie reasoned, would be permissible.

FROM CLUES gleaned in frames from Red newsreels, like the one below, our experts determined that the cosmonauts' cabin was inside a sealed capsule



MARCH 1963

And Vostok's orientation at the re-entry signal must be accurate within 0.75 degree.

"These are the limits of permitted error," Ritchie told his team. "Now, what size of target do the Russians need if such a ship is going to hit it 95 times out of 100?"

The investigators picked, arbitrarily, several impact area sizes that seemed reasonable for this size ship. Working backward from these target sizes, they found the sets of errors that could be tolerated by each. Finally, they found a target size that was close to Ritchie's specifications. Once in the right ball park, they were able to refine their equations for the computer. Here's what it said:

A re-entering Vostok can hit an area 500 miles in diameter 95 percent of the time.

What percentage of the time Vostoks can hit the center could not be calculated, but they can succeed most of the time.

Questions Bring Answers

"What about launching?" Ritchie asked. "What's the chance of a perfect orbit?"

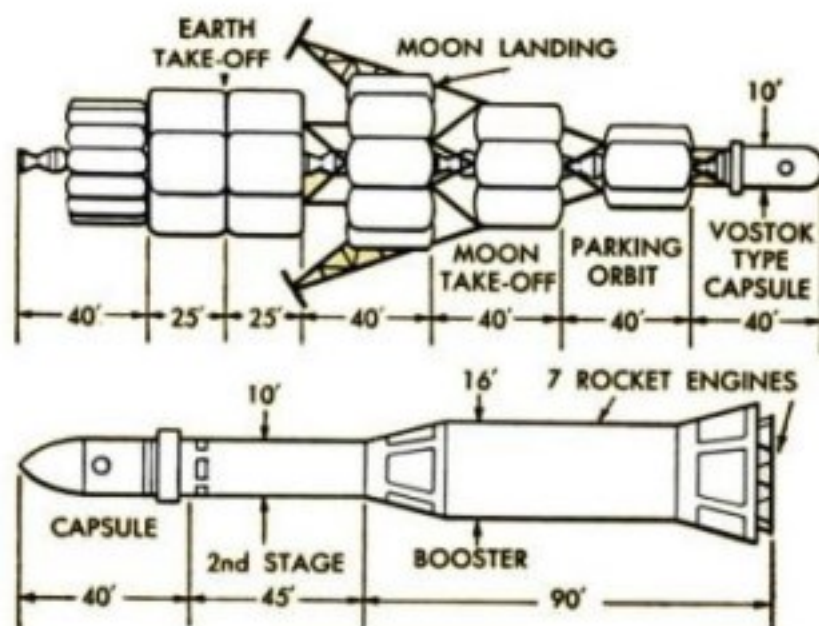
The scientists went back to accuracy figures on perfect circle orbits and orbits actually achieved. The differences showed that the maximum permissible error in speed on injection into orbit is 100 feet per second. The angle had to be accurate within 0.45 degree. Any launch that met these limits could be considered "perfect."

Computer analysis indicated that the Russians can expect to achieve a "perfect" orbit 43 percent of the time.

Ritchie's teammates have moved on to other fields, but he still devotes all of his non-workday energies to analyzing Soviet space and military rocket programs. However, he is not alone. There are perhaps a

[\(Please turn to page 228\)](#)

A MOON LANDING VEHICLE, top, could be assembled in space with 33 payloads in booster, below. Voyage around the moon would require only seven launches

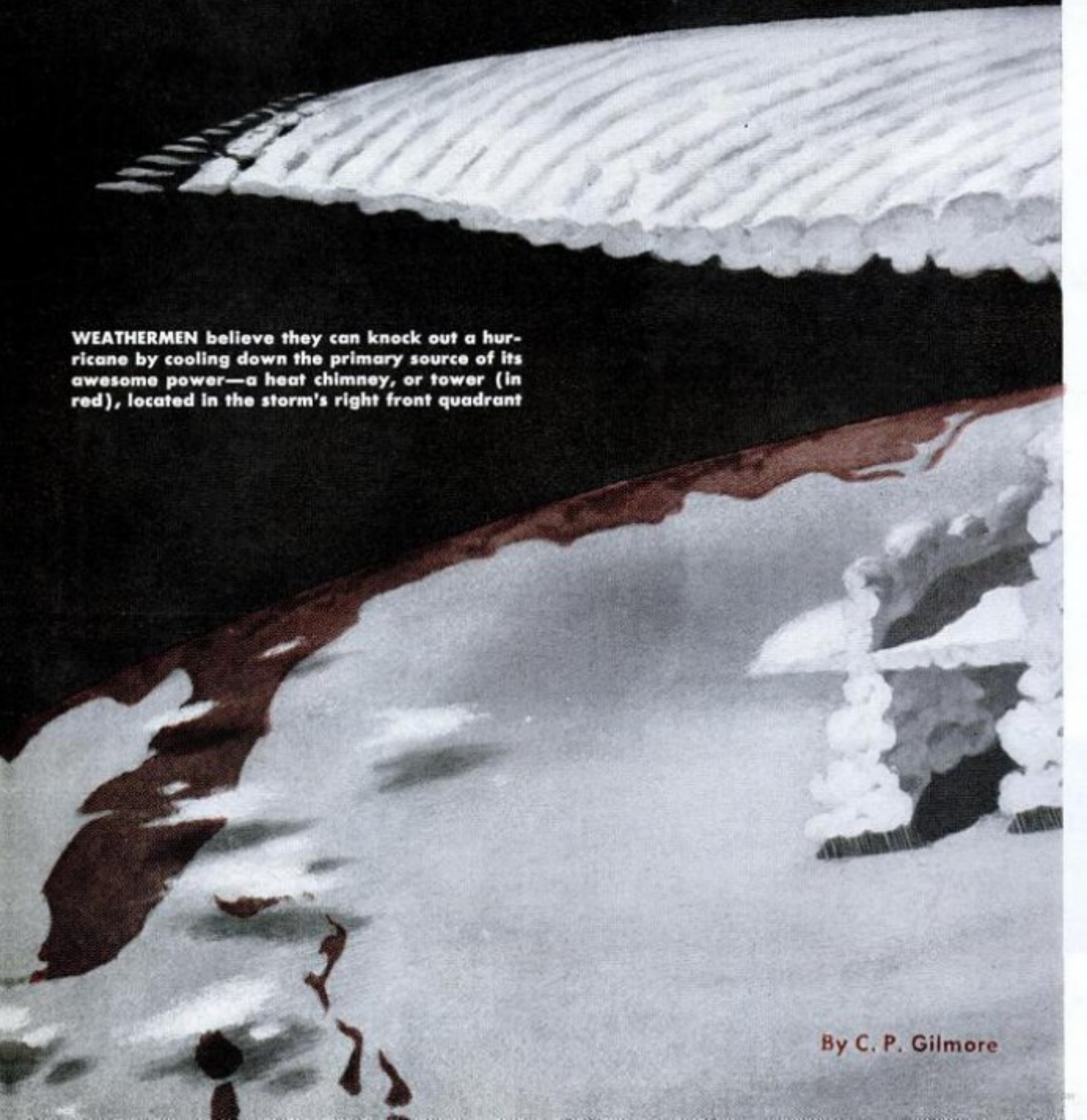


HURRICANE KILLERS

THE MORNING of September 16, 1961, was blustery and gray as a Navy A3D took off from an airport not far from San Juan, Puerto Rico, flew out over the Atlantic, and into the swirling, frenzied heart of Hurricane Esther. As the aircraft sliced through the turbulent air near the storm's eye, it spewed

some 100 pounds of silver iodide crystals into the hovering clouds.

Dr. Robert Simpson, chief of the Weather Bureau's Severe Storm Section, told meteorologists about the event in Washington later. "Nothing cataclysmic happened," he said. "But there were interesting changes observed."



WEATHERMEN believe they can knock out a hurricane by cooling down the primary source of its awesome power—a heat chimney, or tower (in red), located in the storm's right front quadrant

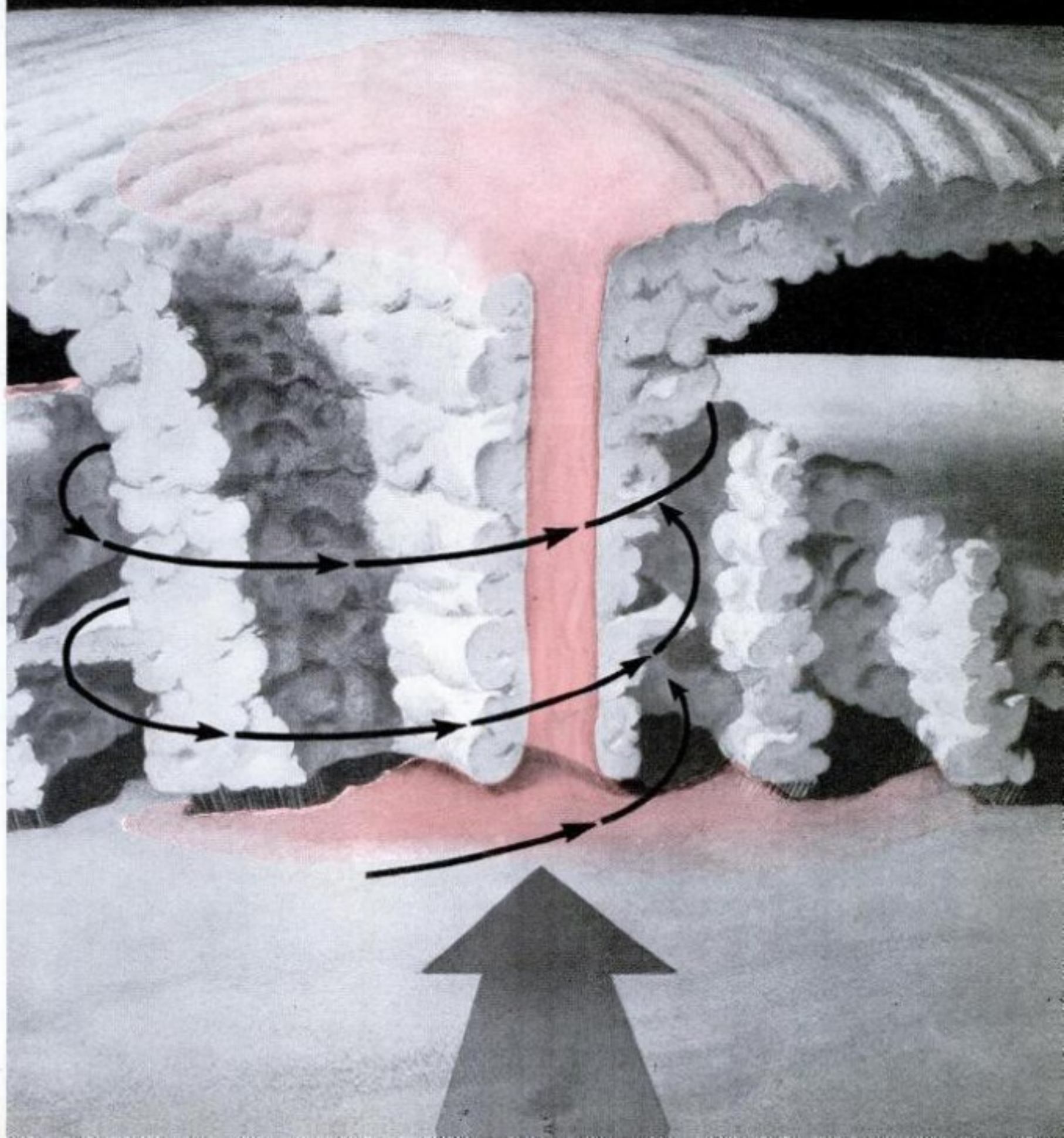
By C. P. Gilmore

LEARN WHERE TO AIM

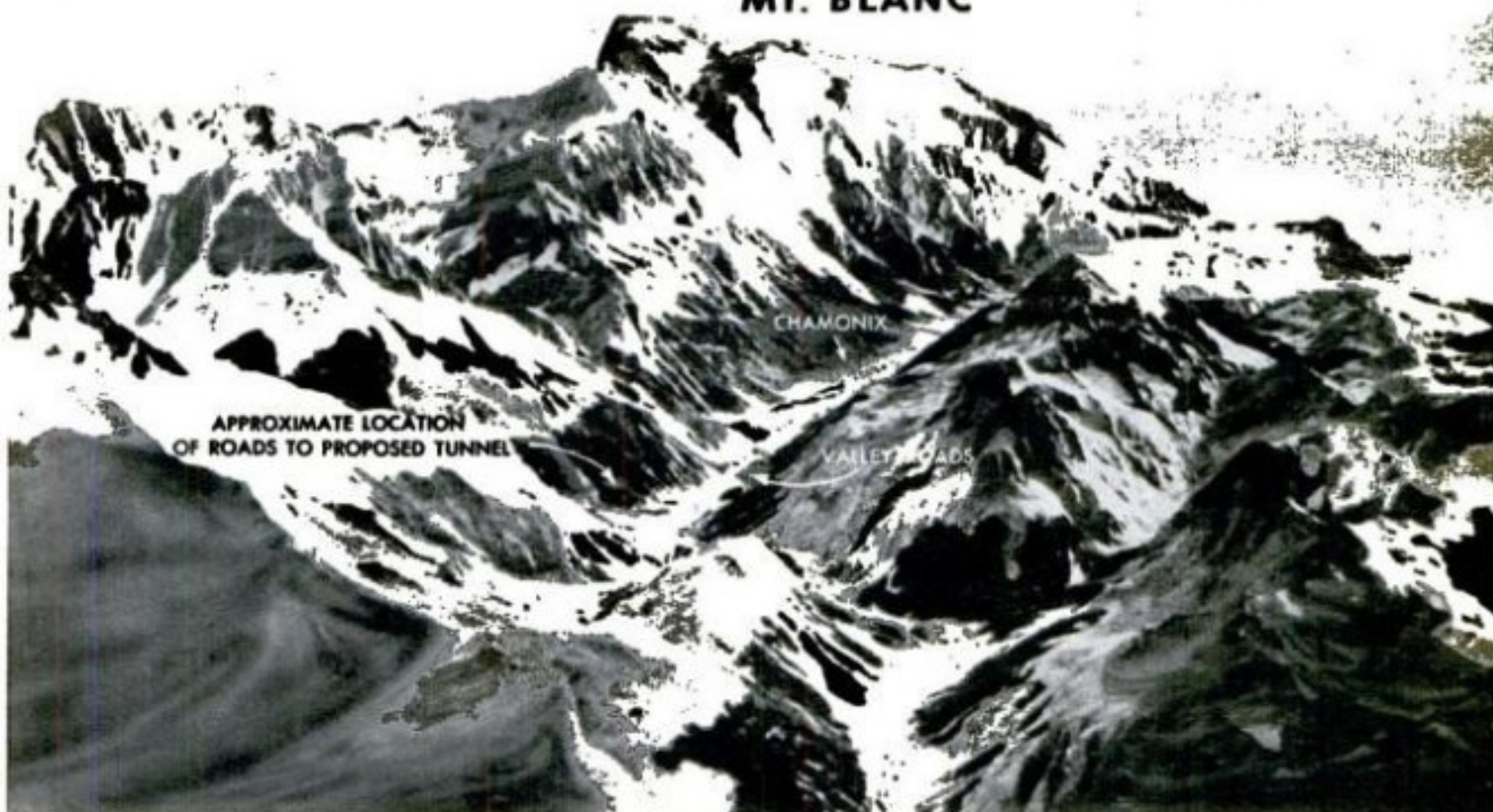
Yet this operation, described in the ultra-cautious terms scientists use, may turn out to be the most important meteorological event since the Flood. For in spite of its outwardly unspectacular results, the experiment near Esther's core has put us "on the threshold of control"—as the Weather

Bureau chief, Dr. Francis Reichelderfer, put it—of one of nature's most destructive forces. In other words, we're about to lick hurricanes.

The chain of events that led up to this meteorological landmark began in the late 1940s. Simpson, fascinated by hurricanes for years, began hitching



MT. BLANC



Model of Mont Blanc shows the proposed location of French entrance to the tunnel near the town of Chamonix

to PIERCE MONT BLANC

DRIVING through the Alps in a tunnel may not be scenic, but it is practical—so practical, in fact, that thousands of cars before long may be doing it every week.

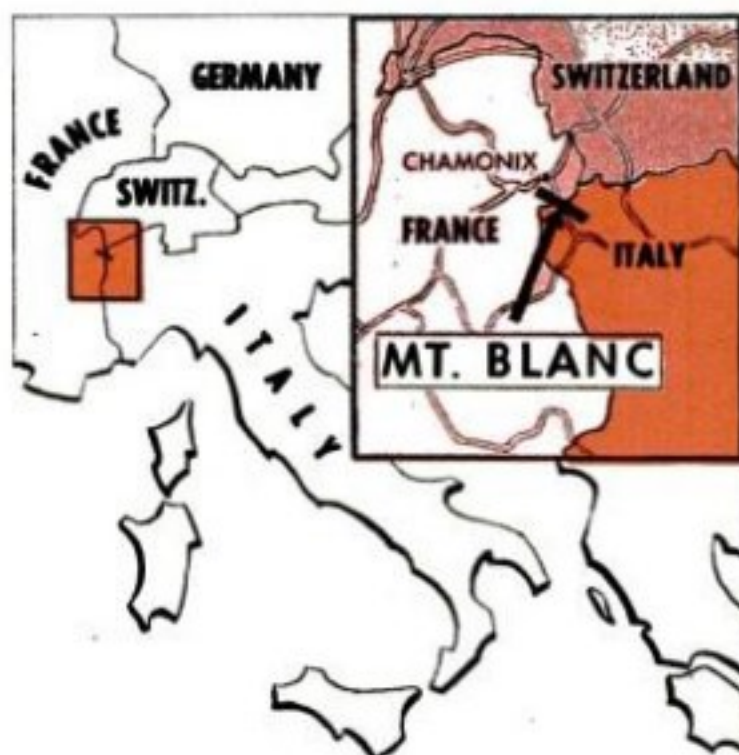
After years of planning, the three governments involved, France, Italy and the Canton of Geneva, Switzerland, have agreed on the details. The tunnel, about $7\frac{1}{2}$ miles long, will burrow under the Alps' highest peak, Mont Blanc, and will reduce the summer road route from Geneva to Milan by 75 miles. The shortest year-round road route will be cut 200 miles.

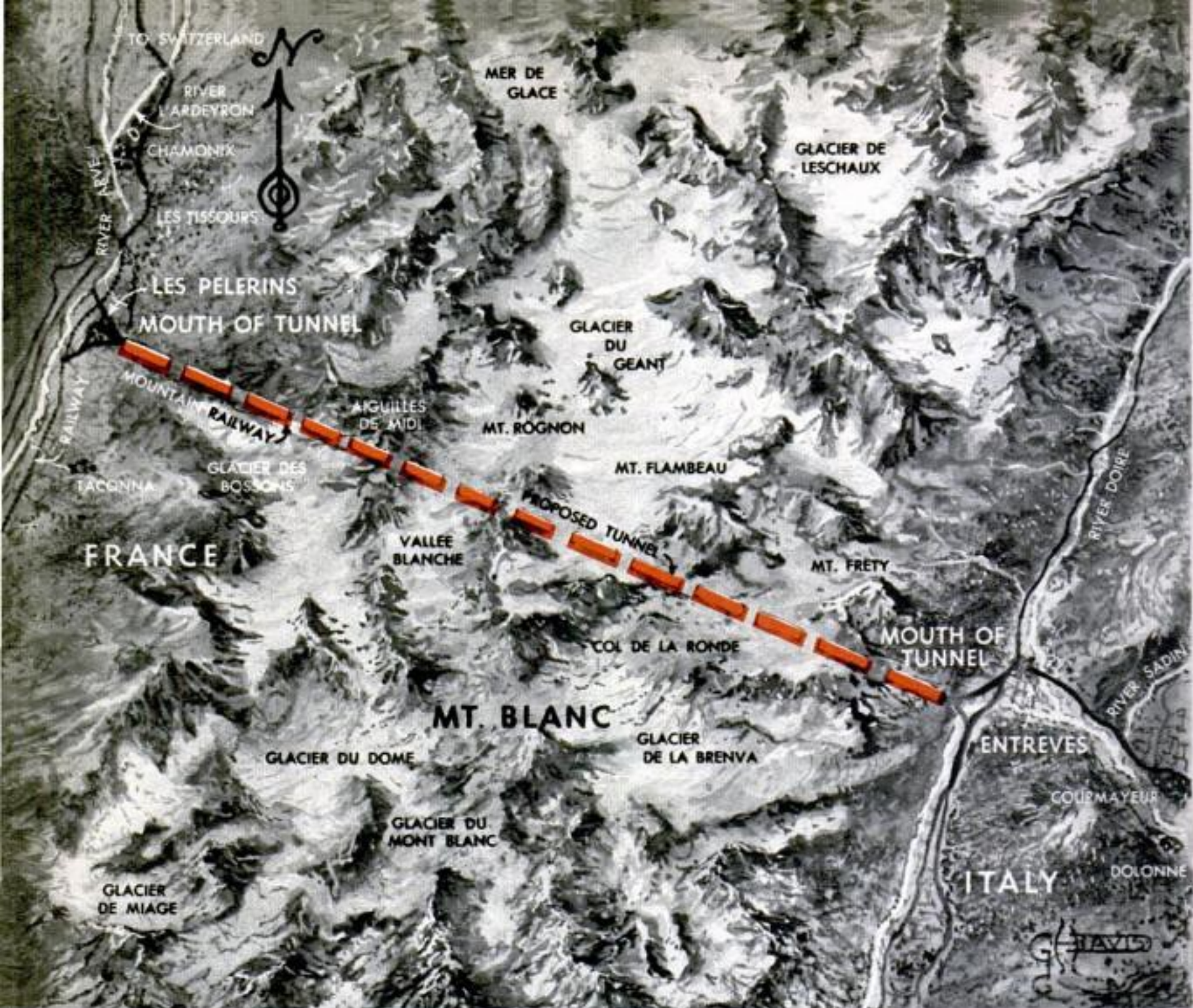
But miles are not a true measure of the tremendous value of the tunnel. Time saved is the real test. The passes, open only from May to November, involve long, arduous climbs. In every case they rise to heights well over 3000 feet, and the St. Bernard pass, most famed of all, requires a climb of 8094 feet—an auto trip that may be spectacular, but certainly not speedy.

It takes about 90 minutes for a first-class car to cross the average pass—the tunnel will shorten the trip to about 12 minutes, with much less strain on driver and vehicle.

Providing a short, all-weather route across the Alps, the tunnel will serve France, Italy and Switzerland

There is expected to be little difficulty boring the $7\frac{1}{2}$ -mile hole through rocks which are described by geologists as easy to work with the exception of a 1000-foot section. Water infiltration and rock temperatures are not unusually high. The slope of the tunnel will be not more than





Tunnel (see dotted line) will bore beneath the massive mountain range that separates France and Italy

four percent, allowing drainage through the tube and also assisting in ventilation.

Six ventilating stations in the tunnel will collect the exhaust air. It will be drawn to the tunnel ends by large fans. Another set of fans will force fresh air through ducts below the roadway. Temperature and air-pollution gauges will keep the control stations informed of atmospheric conditions prevailing inside the tunnel.

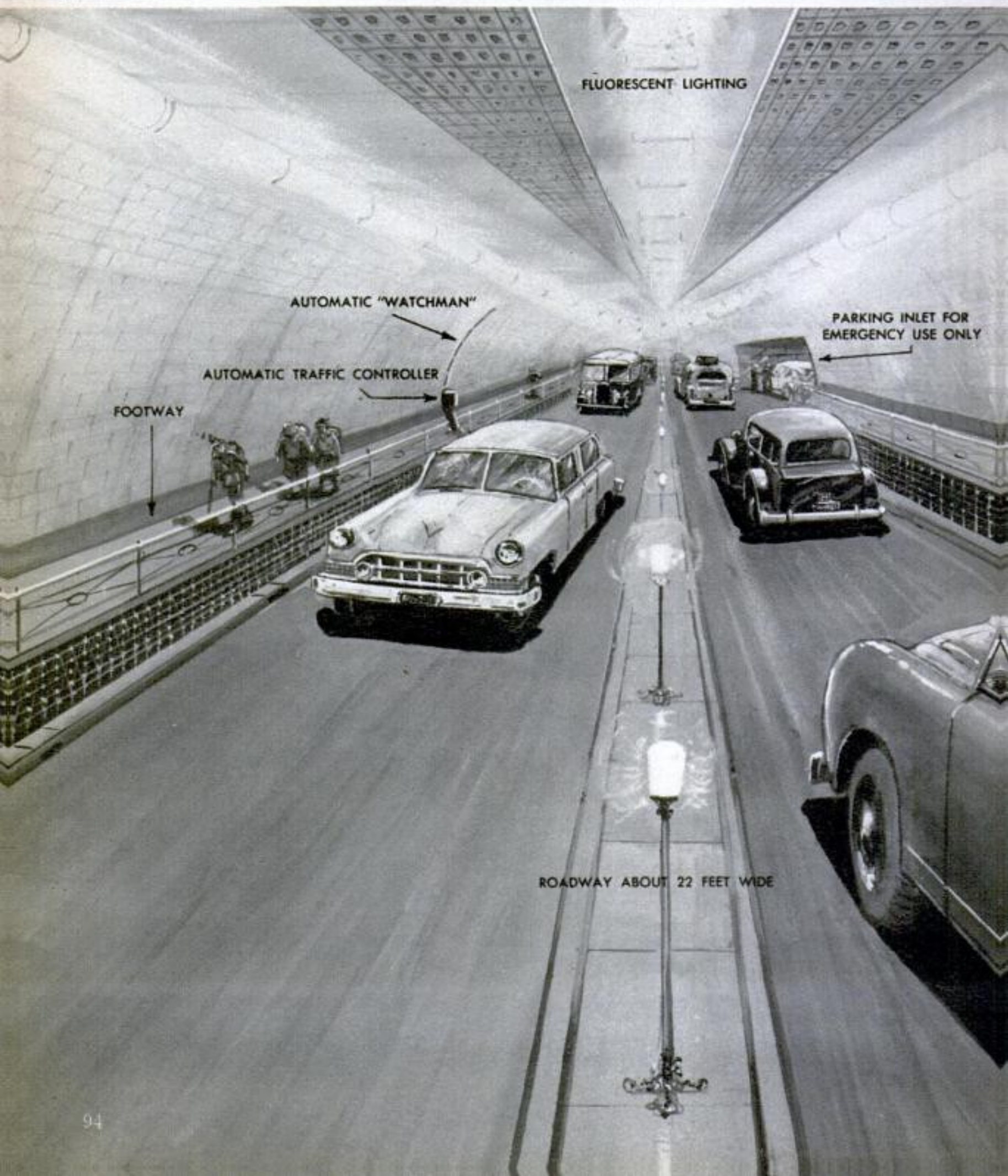
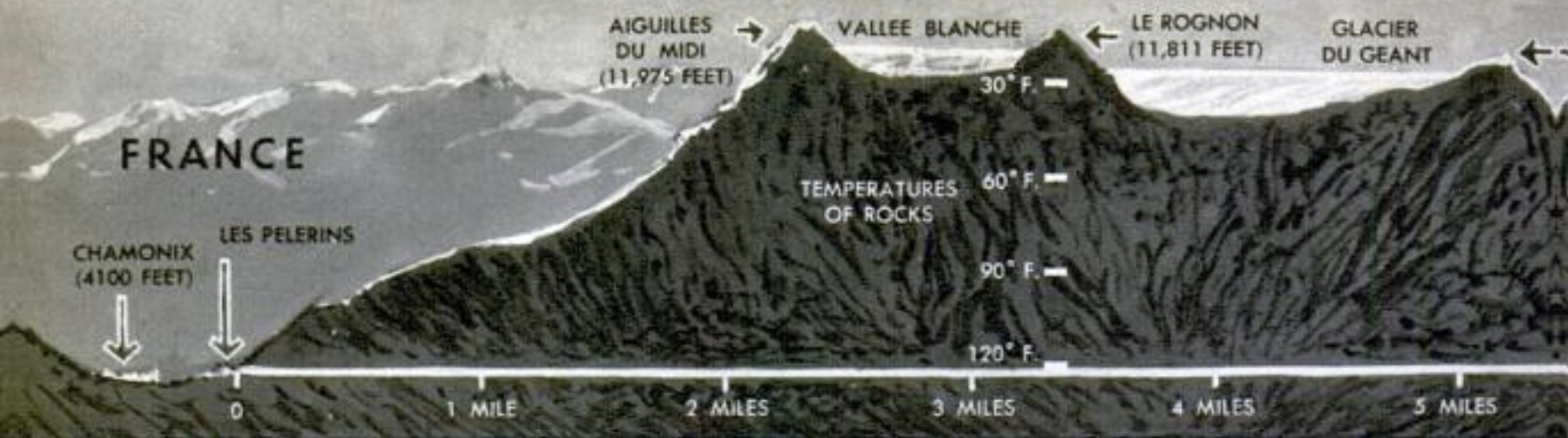
Traffic will be regulated by a novel signal-light system that will keep cars a stated distance apart at all times. Emergency havens will be located along the tube to allow disabled vehicles to pull out of the way. Mechanics will be on duty continually for such emergencies.

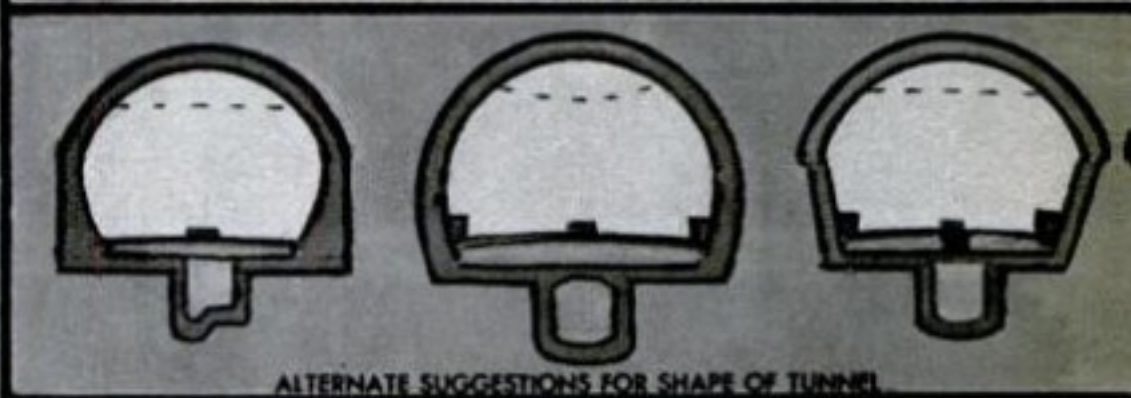
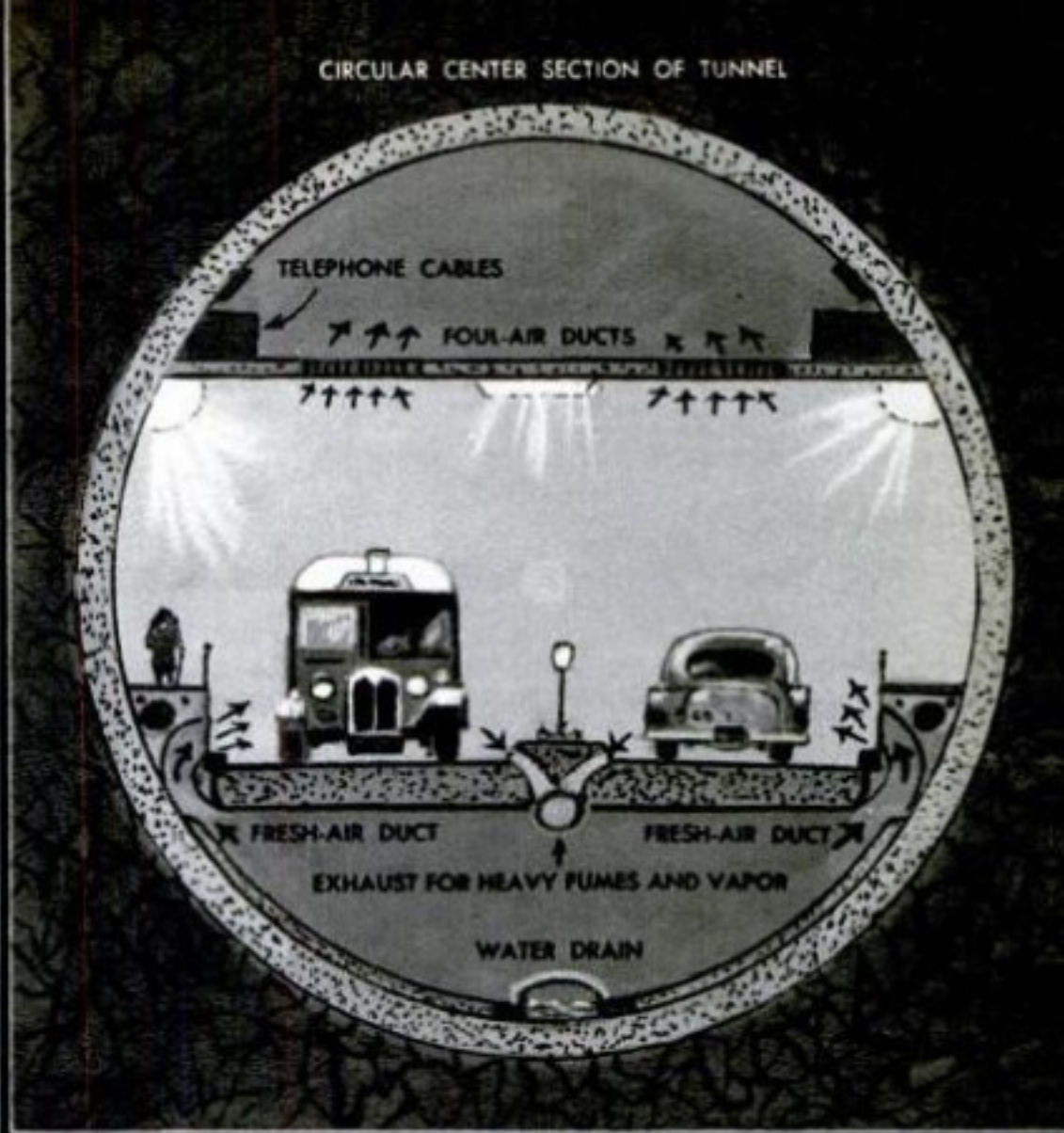
Conservative estimates set the annual traffic at a minimum of 200,000 vehicles. A toll charge, about \$1.50 for a small car with four passengers, is to be made by the private company that will operate the tunnel for profit. This company, incidentally, will invest about 35 percent of the total cost of construction. Traffic is expected to increase

greatly as tourists learn of the ease with which they can drive across a mountain range that had previously been a discouraging barrier. Plans call for opening the tunnel to passenger cars during the day and to trucks at night. More than 500,000 tons of freight will be hauled annually through the tube.

Although the tunnel site is beneath the highest portion of the Alps, it is also at the narrowest, reducing the length and cost of the tube to a minimum. Year-round entrance roads at each end are already in existence, except for the last mile or so. However, considerable work will be done on the Italian side to straighten and widen some of the valley roads leading to the tunnel from the south.

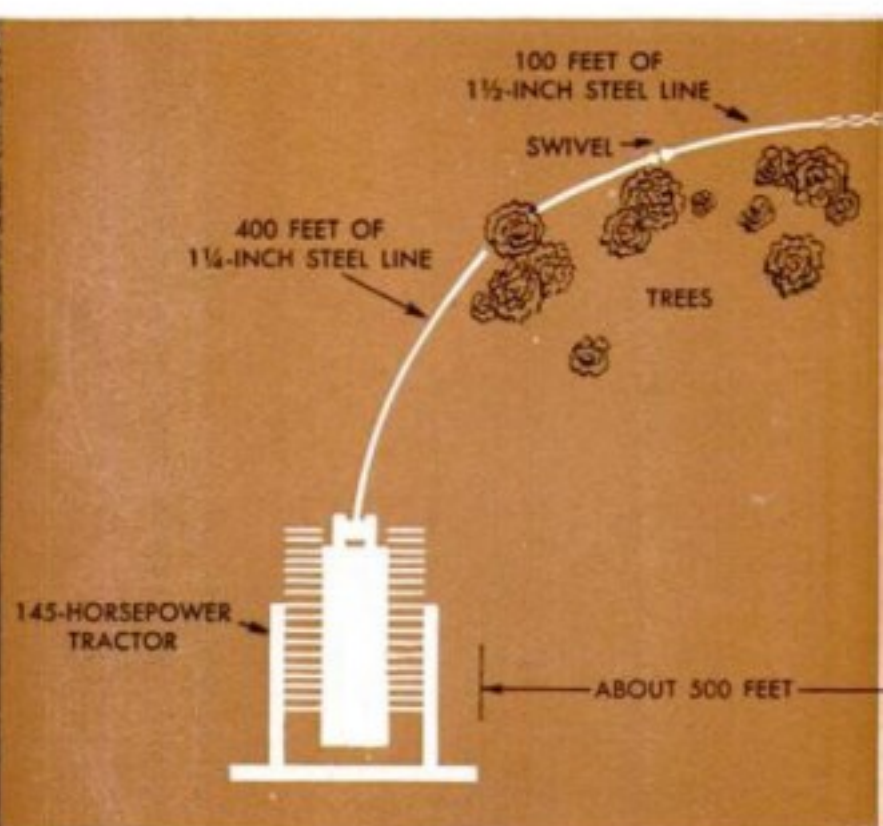
No total-cost figures have been made public. Whatever the cost, though, it is expected to be a profitable investment because it will open an all-year transport route between two extremely populous and industrialized regions. In addition, its appeal to the motorist is expected to be tremendous.







Big steel ball holds line off ground during mowing operation to avoid stumps of large trees logged out

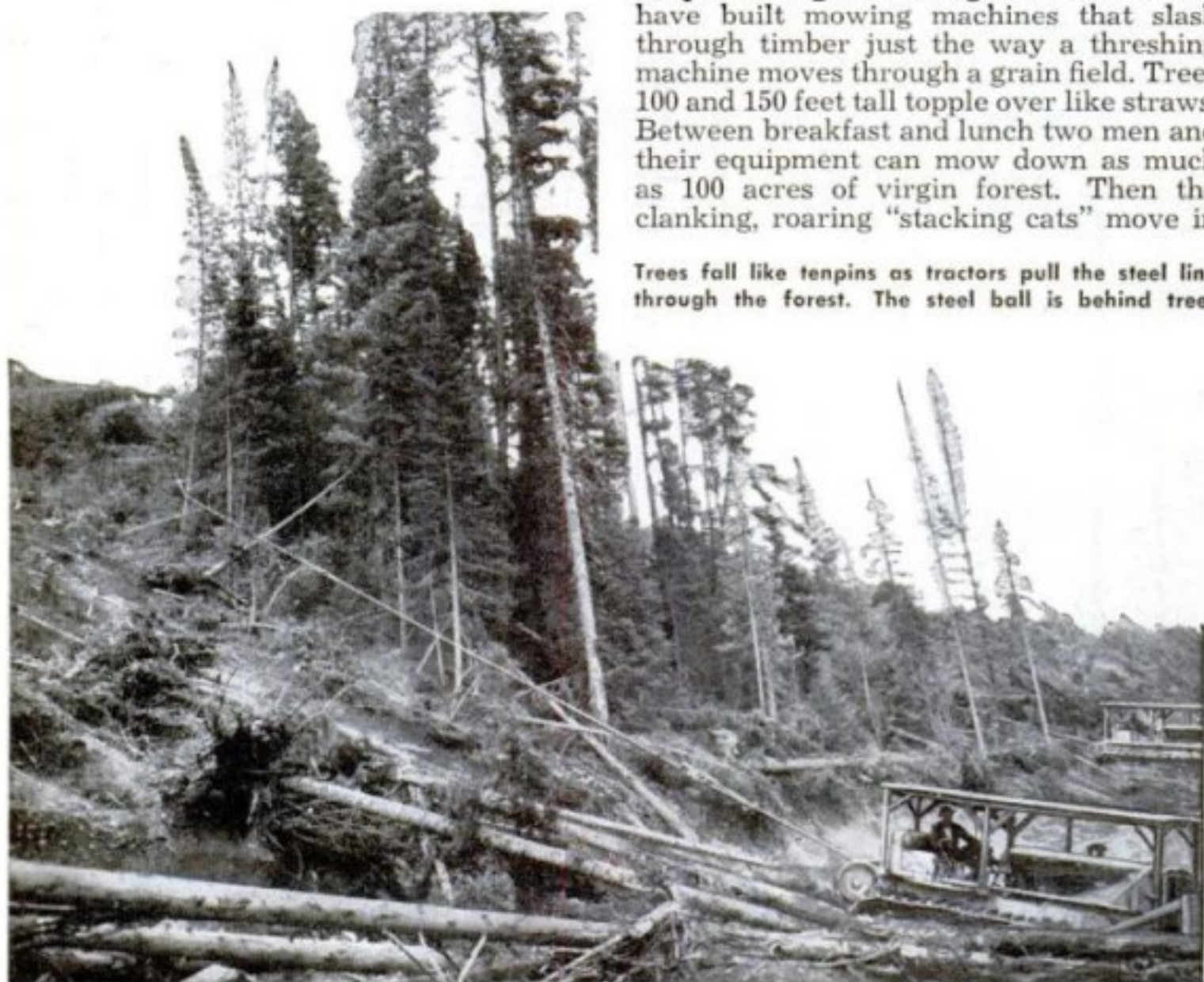


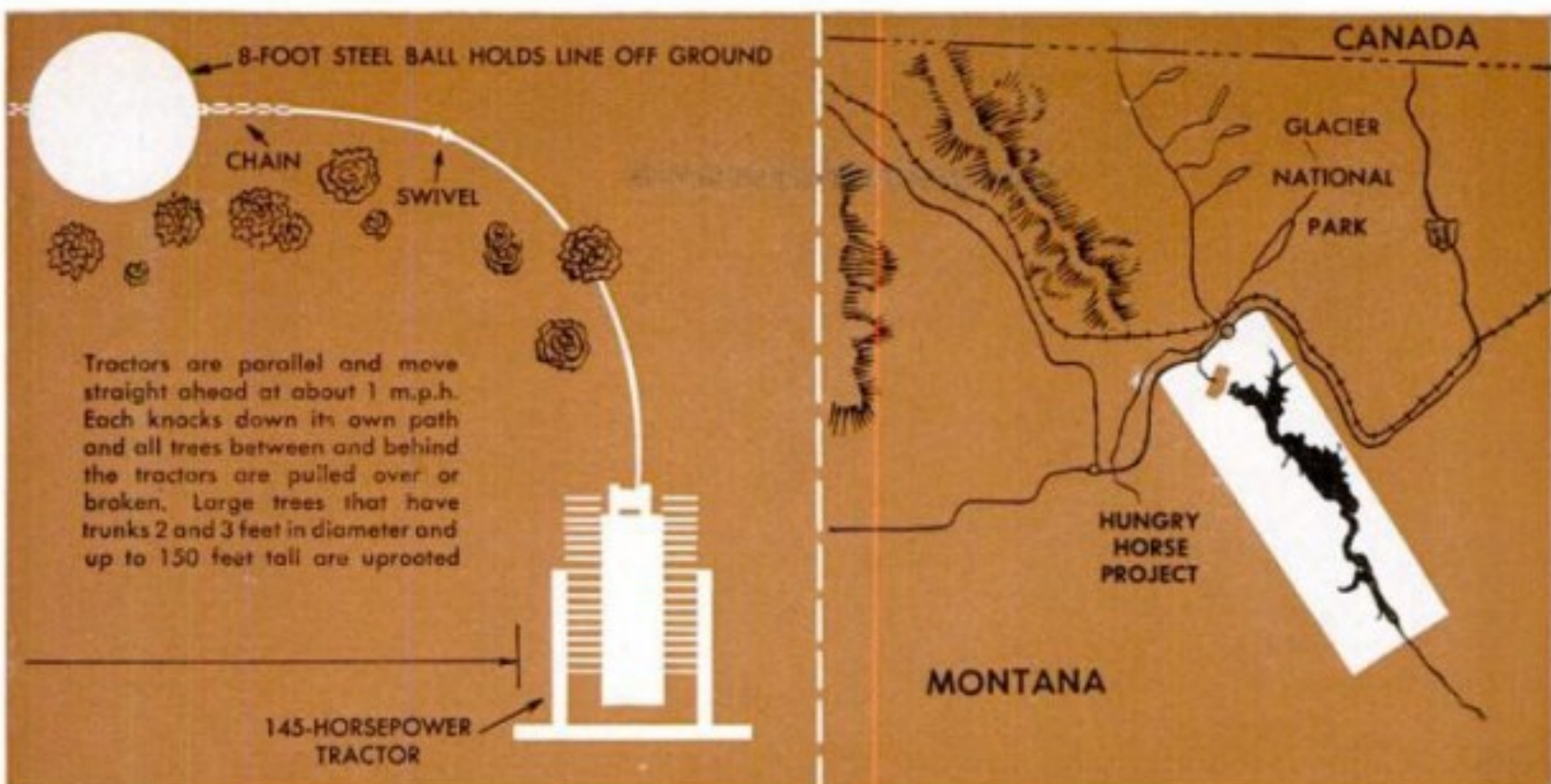
"Bowling" Down

MOW DOWN a forest like it was a field of wheat? Not even the legendary Paul Bunyan could do that.

But wait—up in northern Montana a couple of ingenious engineer-contractors have built mowing machines that slash through timber just the way a threshing machine moves through a grain field. Trees 100 and 150 feet tall topple over like straws. Between breakfast and lunch two men and their equipment can mow down as much as 100 acres of virgin forest. Then the clanking, roaring "stacking cats" move in

Trees fall like tenpins as tractors pull the steel line through the forest. The steel ball is behind trees





Forests for a Super Dam

and rake the fallen trees into windrows.

These Gargantuan operations are taking place in the reservoir area back of Hungry Horse Dam which, when completed in 1953, will be the fourth largest concrete dam in the world. The reservoir site is 34 miles long and up to 3½ miles wide, some 35 square miles in all. Before the clearing operations began it was covered with a thick forest of pine, fir, larch and spruce.

The area contained 80,000,000 board feet of merchantable timber and the first task was to log these trees, saw them up and haul the lumber out. This left hardly a dent in the thick forest.

Every tree that remains, almost every

twig, must be removed and the ground scraped clean before the site can be used as a reservoir. Otherwise trunks and limbs would be floated by the rising water and would drift down and clog the debris booms and the trash racks that will guard the intakes of the 285,000-kilowatt powerhouse.

When the Bureau of Reclamation asked for bids for removing the first portions of the 25,000 acres of forest, smart engineers from as far away as Louisiana and California tried to figure out the cheapest way of clearing the trees.

Twin rig for clearing away fallen trees is made of two tractors that push a 21-foot rake with 13 teeth



AUGUST 1950

35 CENTS

ANC



POPULAR MECHANICS MAGAZINE

WRITTEN SO YOU CAN UNDERSTAND IT

REG'D. TRADE MARK, GREAT BRITAIN, No. 40426

OFF.



**"BOWLING" DOWN FORESTS
FOR A SUPER DAM—Page 90**

BOAT-LIFT

Rolls Into Water

When the Boat-Lift is positioned over the trailer, canvas straps are fastened around the hull and the boat is carried toward the water



TO SMALL-BOAT ENTHUSIASTS, the bane of every week end is hoisting the boat off of and onto the trailer and toting it into and out of the water. Sam Davis, a San Pedro, Calif., inventor, has devised a machine (also shown on cover) that will do the job automatically in little more than a minute. Called the Boat-Lift, the new machine resembles an oversized lumber carrier and it operates on the same basic principle.

The Boat-Lift is driven over the trailer-borne craft, straddling it, and two canvas straps are cinched around the boat's hull. An 85-horsepower truck motor, supported by a pair of steel members across the top

of the machine, operates a power take-off which lifts the boat from the trailer.

Riding on 34 by 9.9 aircraft tires, the Boat-Lift carries the craft across the beach and into draft-deep water, where it is lowered. Slotted-metal landing mats stretched across the soft sand keep the heavily burdened Boat-Lift from bogging down as it moves to the water's edge.

Constructed of steel pipe and channel steel for lightness and strength, the machine is 10 feet long, 8 feet 4 inches wide and stands 8 feet 4 inches tall. The Boat-Lift will handle small craft up to 22 feet long and 5 feet high, with a beam of 7 feet and weighing 3000 pounds.

Once in deep enough water, the boat is lowered and the straps undone. Device handles craft up to 22 feet long and weighing 3000 pounds



SEPTEMBER 1953

35 CENTS

POPULAR MECHANICS MAGAZINE

WRITTEN BY MEN WHO CAN UNDERSTAND IT

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*Boat Launcher
Page 125*



In This Issue

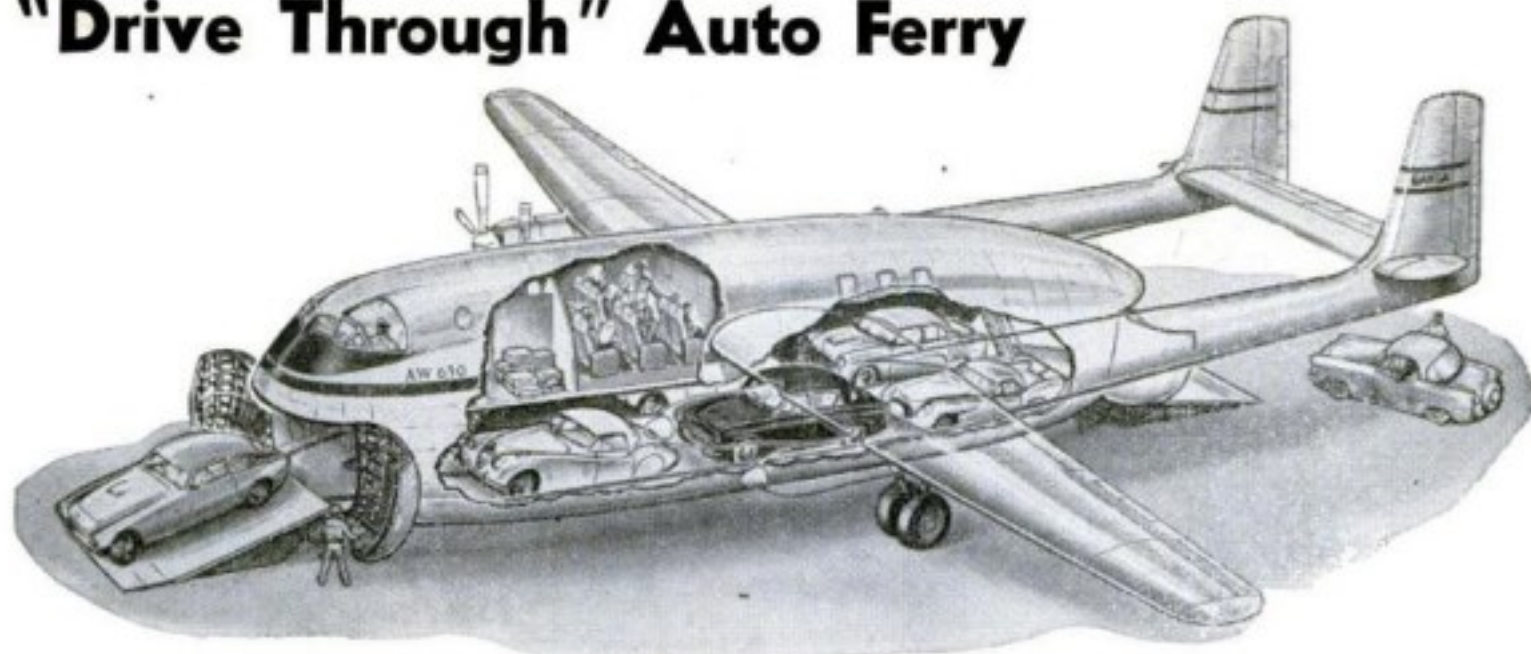
ROUNDUP OF THE STATION WAGONS

What Owners Say About the
STUDEBAKER

For the Craftsman
BUILD YOUR OWN CORNICES



"Drive Through" Auto Ferry



Someday an airline passenger will be able to drive his automobile into the rear of a British-built plane, fly economically to his destination, and then drive away out the front of the craft.

These are the specifications of a new airplane that will carry 30 tourist coach passengers in its top deck and six automobiles below. The cars will be able to drive straight through the fuselage using doors at both ends.

The plane is being built by the British firm of Hawker Siddeley, manufacturer of the Hawker Hunter and other military aircraft. A prototype is scheduled for completion next year.

It is designed to be a medium-range, economical multipurpose airplane to provide passenger and freight service at low cost. Powered by four Rolls-Royce turboprop engines, it will have a cruising speed of 300 miles per hour at 25,000 feet altitude and a range of over 2000 miles.

An all-air-coach version would carry 80 passengers, a military type would transport 70 troops and their accessory equipment and vehicles, and an all-freight adaptation would have a pay load of more than 25,000 pounds.

Initially, the British firm plans to build 10 of the airplanes, and hopes to sell them there and in other countries.

Five-Ton Roller Made From Culvert

Crushing the lumps of plowed soil is sometimes necessary in irrigation farming. A Colorado farmer does this with a roller he made by filling a section of 36-inch culvert with four tons of concrete. Axle and tongue add another ton of weight.



Tractor Moves German Farmer

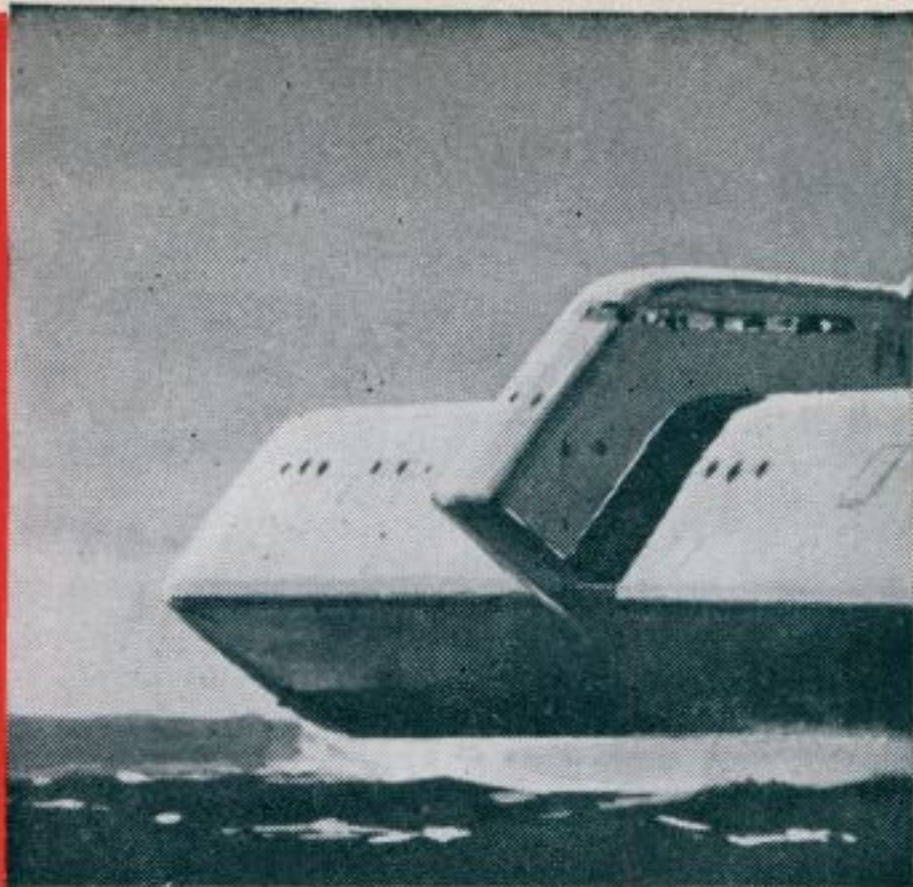
When a farmer in West Germany moved into a new home recently, he found the stairway was too narrow for some of his furniture. He solved the problem by loading the furniture on the fork-lift attachment of his tractor and raising it to a second-floor window.



The Sea-Gem:

a 100 mph Air-Cushion Ship by 1963

By JAMES JOSEPH



NON-ELECTION year 1963 may nevertheless bring a spectacular inauguration.

Some time next year, America's first air-cushion ship, the Sea-GEM (for sea-going ground effect machine) may streak New York to London on her maiden "flight."

Riding 3 to 6 ft. above the waves on a frictionless cushion of air, the giant 100-ton craft will be propelled at better than 100 mph by four jet-prop pusher-type engines.

Part ship, part plane, and wholly revolutionary, the Sea-GEM promises its 100 first-flight passengers some surprises.

Your seat-belt cinched, you'll scarcely notice when the aluminum and stainless steel craft makes the transition from land to water. Though you'll be "airborne," the ocean will

be but a yard or two below you. Between you and the sea will lie nothing but air—a low-pressure air cushion churned into being by the Sea-GEM's dual horizontal fans. "Afloat" but almost "flying," you'll feel no sea-sensation, no roll or pitch. Nor will the thundering jet engines (a total 22,000 hp) be audible through the aircraft-like hull. Thirty super-smooth hours after leaving New York, you'll "land"—actually, slide up a ramp—in London.

The figment of a naval architect's imagination?

Not at all. The U.S. Maritime Administration announced recently that it's negotiating a \$370,000 Sea-GEM design-study contract with Vehicle Research Corp., Pasadena, Calif., and its subcontractor (and probable Sea-GEM builder), big Douglas Aircraft Co.

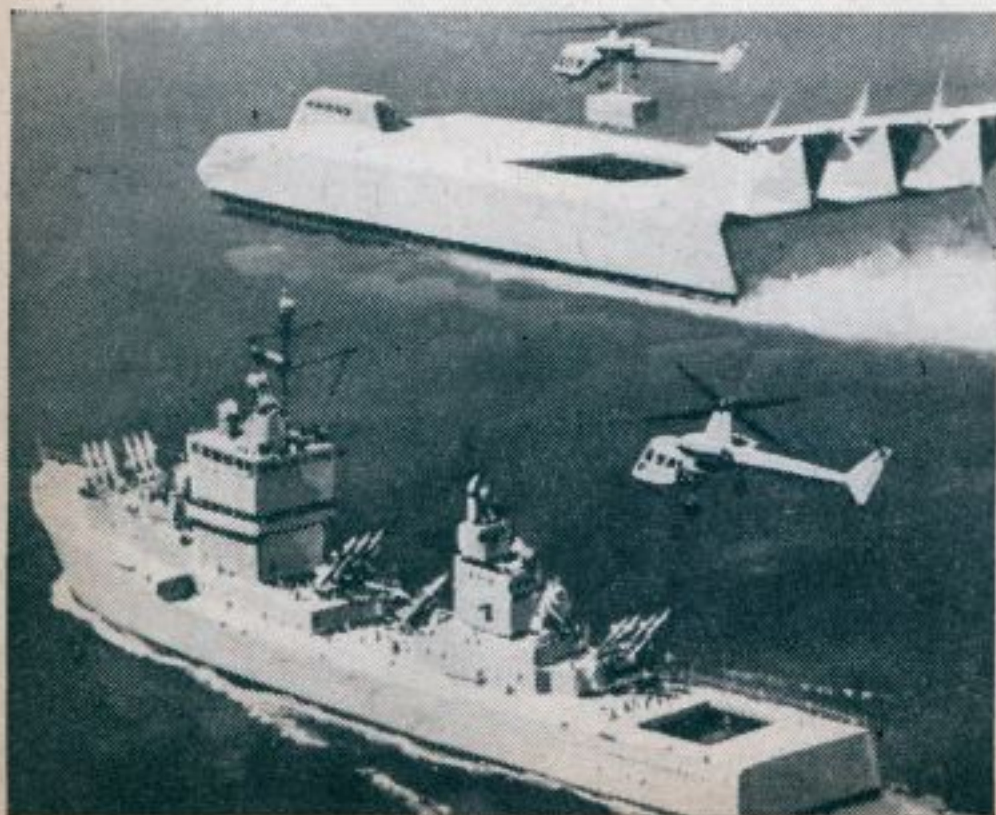
The Maritime Administration's admitted goal: to launch the craft by 1963.

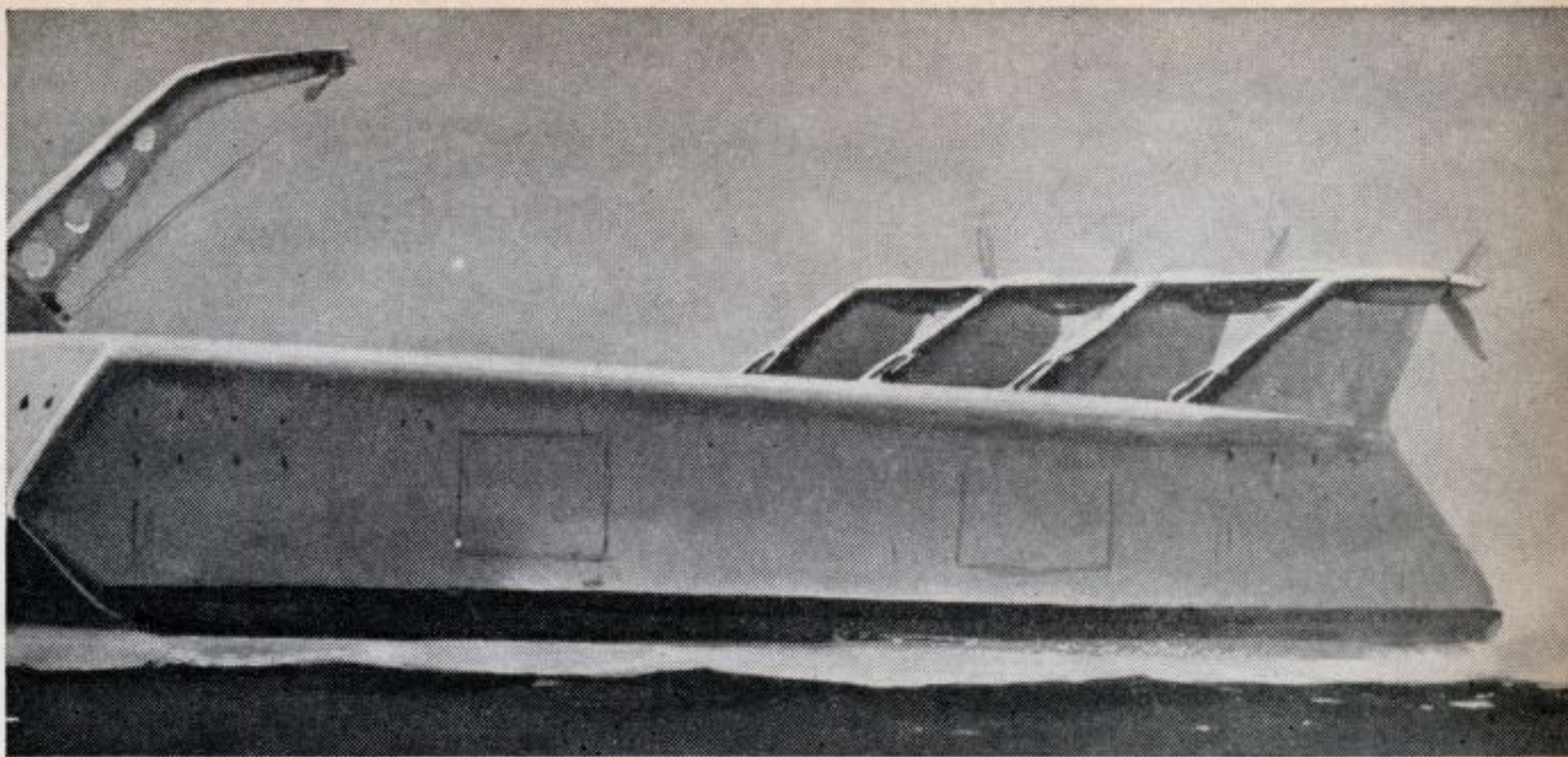
"We've been at work on the project for some time now," confirms Dr. Scott Rethorst, Vehicle Research's president and one of our country's foremost aerodynamicists.

The first Sea-GEM probably will be the 100-ton model, but Douglas Aircraft's president, Donald W. Douglas Jr., recently indicated there is almost no size limit. He pegged as "most efficient," sea-skimmer ships in the 500- to 1000-ton class.

The Sea-GEM, although using the

Cargo could be transferred from Sea-GEM by crane-helicopters operating from its flat deck.





same air-cushion principle (see page 73, June '60 S&M), will resemble neither Britain's now abuilding 25-ton SRN-2 (which is powered by four turbine engines) or several U.S.-sponsored GEM-vehicles, including the now-declassified Avro craft. Pentagon insiders say the Avro failed, in wind-tunnel tests, to meet military altitude specs.

In contrast to the Avro, the Sea-GEM will, at most, skim the water, its great weight supported by the cushion of air (only about $\frac{1}{4}$ psi, or 36 lbs. per square foot). Douglas estimates that even a 500-ton craft would operate about half of the time at just 3 ft. or less above the surface—closer in calm seas; higher, and probably slower, when it's rough.

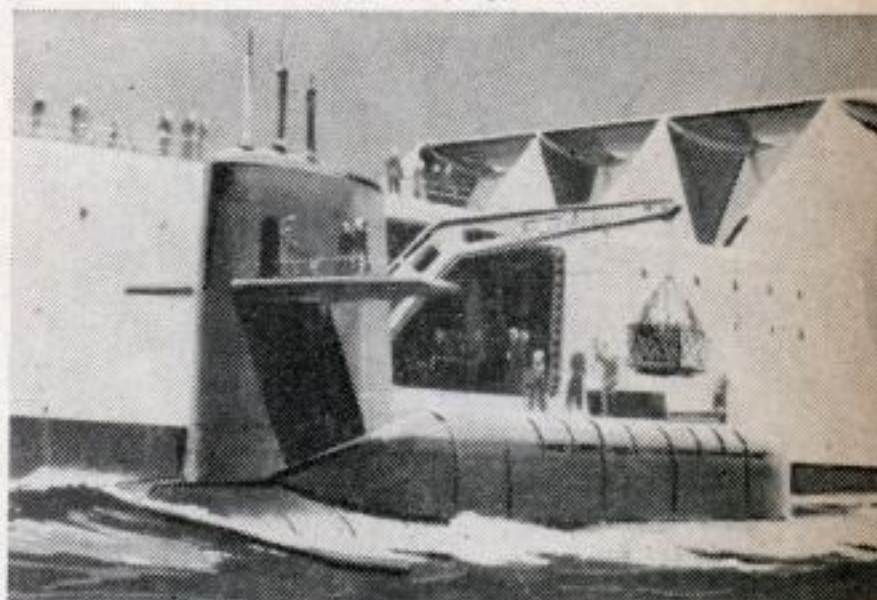
For its main propulsion, the craft will depend on its four jet pusher engines. But propulsive power, even for the 500-ton ship envisioned by Douglas, won't need to be anywhere near as big as for either jet planes or helicopters. Reason: The jet engines' total power is translated into thrust; none of it (as in aircraft) is squandered on lift.

Artist's drawings of the first 500-ton craft confirm Donald Douglas's statement that "the craft's configuration will tend toward a low, functional profile with essentially straight-line elements which permit the structure, although aircraft type, to be simple and low in cost."

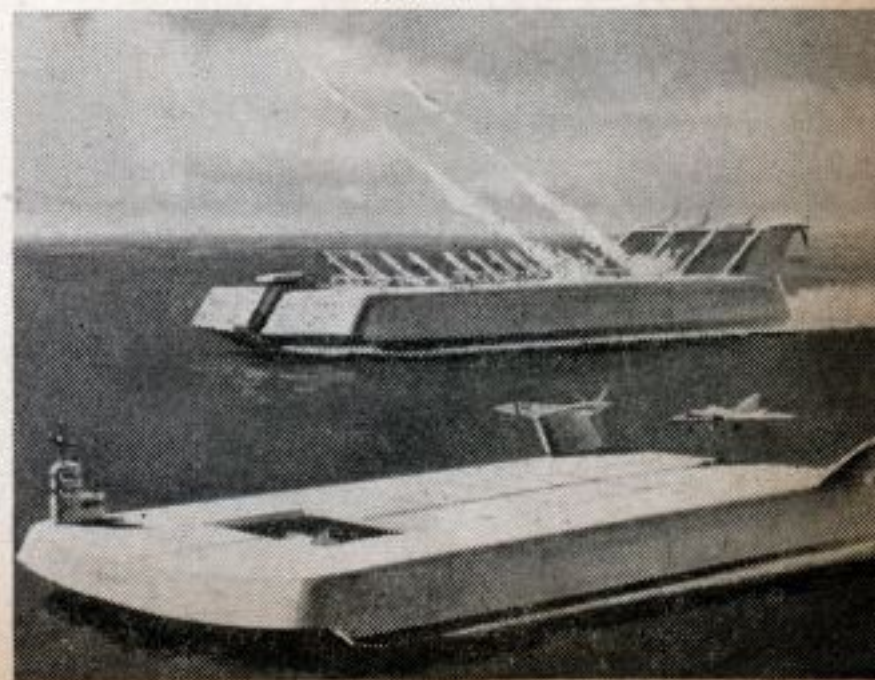
Although the Maritime Administration's underwriting of the first Sea-GEM ostensibly aims at faster, more economical over-water transport, the Navy is also eyeing the craft as a multi-functioned amphibian: a land-to-water assault and supply ship.

Here's the Sea-GEM as an aircraft carrier (foreground) and a missile-cruiser. As a carrier, it has engines mounted outboard, with its control tower far to starboard.

The 500-ton cargo-passenger Sea-GEM will look like this. Jet-prop aircraft engines are mounted astern. Vertical tail might have movable control surfaces for steering. Control cabin is mounted in the center of the bow, as is cargo crane.



Rushing to a supply rendezvous with a nuclear sub, Sea-GEM could land in water or remain airborne (to reduce chance of sonar detection by enemy sub) to resupply friendly sub while both maintain cruise speeds.





Artist's conception of Soviet air attack against Alaska radar station (at left). General Old, chief of Alaskan Air Command, estimates a minimum of 10% of Russian planes

would break through the U.S. F-94 interceptor defenses. Note Russian bombers high above, heading for the U.S. heartland, while U.S. interceptors duel the Russians.



Can General Old's "Eyes" Guard America's Heartland?

Special from Anchorage, Alaska. Tonight the citizens of the American "heartland"—you Chicagoans and New Yorkers, the people of Detroit and Philadelphia—will prepare for bed, blissfully confident in tomorrow. Yet while you sleep, lights are burning late here in Alaska, particularly in the somber, sandbagged headquarters of the Alaskan Command at Elmendorf Field, just outside of Anchorage. This is a building which never sleeps. For here officers of the Alaskan Command are staying up nights worrying about you "heartland" Americans.

Here, near the top of the world, chill winds blow across the Bering from Arctic Siberia, which by jet bomber lies less than one hour's flight away. And from Siberia, via the stratosphere, it is but $7\frac{1}{2}$ jet hours to Chicago, keystone of industrial America. That's why the strategy-wise enemy sees in Alaska, its three major airfields and other military facilities, the

By JAMES JOSEPH



Soviet bombers, taking off from scattered islands just over the pole, could reach the Midwest U.S. in less than 7 hours. Here, also, are other bases from which longer range, one-way Russian attacks could be made.

logical stepping stone to the American "heartland."

Tonight, radar stations along the bleak Arctic shore from Barter island in the far north, to the Aleutian chain, sweep the horizon. On the shores of the Bering, sharp-eyed Eskimo scouts, keep careful look-out for possible landing parties, and at the Alaskan airfields, jet interceptors are at the ready. One glance at the USAF Strategic Planning Chart of this area will show you the reason for this 24-hour vigil. For on this map and the plans it calls for may hang the survival of millions of "heartland" Americans.

This map shows just how vulnerable we actually are. A few scant hours by fast bomber north of the pole is the great land sweep of Russia, dominated by strategic airfields, any one of which is capable of launching over-the-Pole attacks. It is only 4000-4500 miles from the nearest Siberian bases to New York, an easy one-way jet bomber run. Soviet bombers, setting out from bases lying on scattered islands just over the Pole, could straddle longitude 85° and find themselves in the Midwest U. S. in

something short of 7 hours.

Perhaps these are the reasons that Maj. Gen. Wm. D. Old, chief of our Alaskan Air Command, speaks like a man who fears he may one day lose his eyesight. By eyesight, Gen. Old means his radars. For without his radar screen, the general and his command would be blind, and terribly vulnerable. Gen. Old knows that his radar vision isn't 20/20 even now. As both a flyer (with 9,000 hours) and a graduate electronics engineer, he knows that radar cannot see beyond the horizon; that it can be jammed; that it sometimes fails to operate properly because of ionospheric disturbances. But most important, Gen. Old also knows that enemy fighters could put out his radar eyes, one by one, and leave him open to later attack without warning. And while diversionary attacks hit Alaskan bases, the full fury of enemy bombers would be roaring high overhead, bound for the American heartland.

In an exclusive interview for *SCIENCE AND MECHANICS*, General Old put it this way: "If you were the enemy, what would you do first?"

"I'd put out your eyes—your radars—and blind you."

The general nodded. "That's exactly what I would do." He moved to a map, a scaled-down replica of the Strategic Planning Chart. "This," said Gen. Old, "is the way we're looking at the world today." He meant, of course, from the top down. When strategists think of our imperiled industrial heartland, they picture themselves standing on the North Pole and peering down over the edge of the globe, first toward the U. S., and then about-facing, toward the U. S. S. R. The closeness of the two, via the over-the-Pole route, has made many a strategist gape, for by the jet North Pole route, the once-isolating Arctic Ocean shrinks to pond-size.

Gen. Old swept a hand across the coastline of Alaska. "We have radars here," he said, "but not enough, and anyway, they are open to attack." The general admitted this even though he is aware that Alaskan-based F-94 pilots are standing by 24-hours a day, alert for the call that will order them airborne. And first warning would likely come from coastal radars.

According to General Old, we have now sunk some \$295,000,000 into our radar net, and Alaska has come in for its share of this. It is a big net and a powerful one, but it is far from being fool-proof. The scores of isolated radar stations

spotted along the barren Arctic coast are scantily defended; yet even without massive defenses, each cost upwards to \$5,000,000. "In Alaska you have to figure everything three times normal continental U. S. costs," continued the general. Despite this defensive expenditure, our Alaskan radars are there for just two purposes: to warn of approaching unfriendly planes or ships; to direct ground-controlled interception. Our vast outlay for Alaskan radars has been spent to purchase the Alaskan Command and its troops just one precious hour of time. For 60-minutes' warning is all the Command wants and expects from its radars. If commanders like Gen. Old get that one hour, the money will have been well invested. If they don't . . .

Let's fly north to a coastal radar—one of General Old's "eyes"—to see just how vulnerable it is. This will be a composite picture, not any specific site. Outside it's minus 50° as our plane climbs into the rarefied, brittle-cold arctic altitudes. The pilot points the ship's nose north and somewhere over snow-capped ranges, past Fairbanks, the pilot announces, "we've just crossed the Arctic Circle." Some hours later (we're riding a slow, conventional-engined air-force transport) we let down on a bulldozered airstrip, and a few hundred feet from the strip's squat operational hut stretches the Arctic Ocean.

Radar operating crews, anywhere from 10 to 400 men, live in a huddle of GI shacks around the airstrip. Twenty-four hours each day operators sit at the radar scopes, scanning this station's assigned sector to the horizon. Except for Armed Forces Radio which still maintains a good station at Nome, about the only entertainment comes from Radio Moscow, which on occasion beams in loud and strong. Its music is fair; its propaganda revolting and ominous—the kind that makes these G.I.s know why they're scanning the Arctic coast.

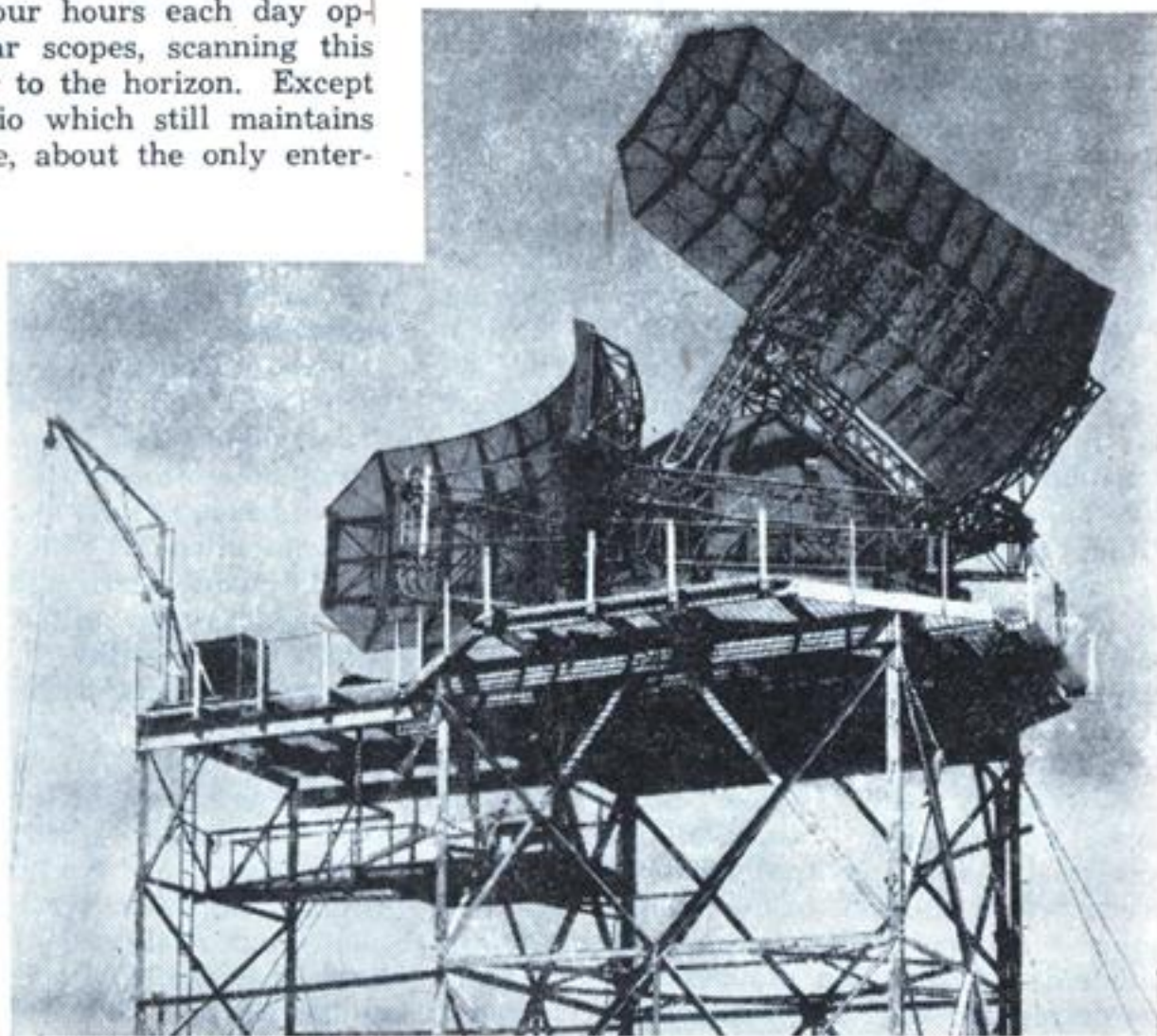
Rising from the airstrip, and lashed by polar winds up to 100 mph, is a steep mountain. High on a pinnacle, with its back to sheer ice walls, stands the radar. Its antenna, marking it as a World War II model with 1952 improvements, sweeps back and forth, over a 180° arc. A ¼ mile down the beach stands an apparatus looking something like a ski-

tow. One by one we're hauled up on this tow to the radar site, along 3000 feet of swaying, ice-sheathed cable. That's how every stick of supply and every timber that went into building this radar shack got there. No wonder each station costs \$5,000,000.

Inside the semi-darkness of the radar shack, operators bend over their scopes, watching as the antennas pick up distant objects, which appear on the scope as little "pips." Most of the "pips" represent ice-ridges. But operators are always looking for the unidentified pip *that moves*. When stations pick up a flight of these one day, you "heartland" Americans will know about it—quick!

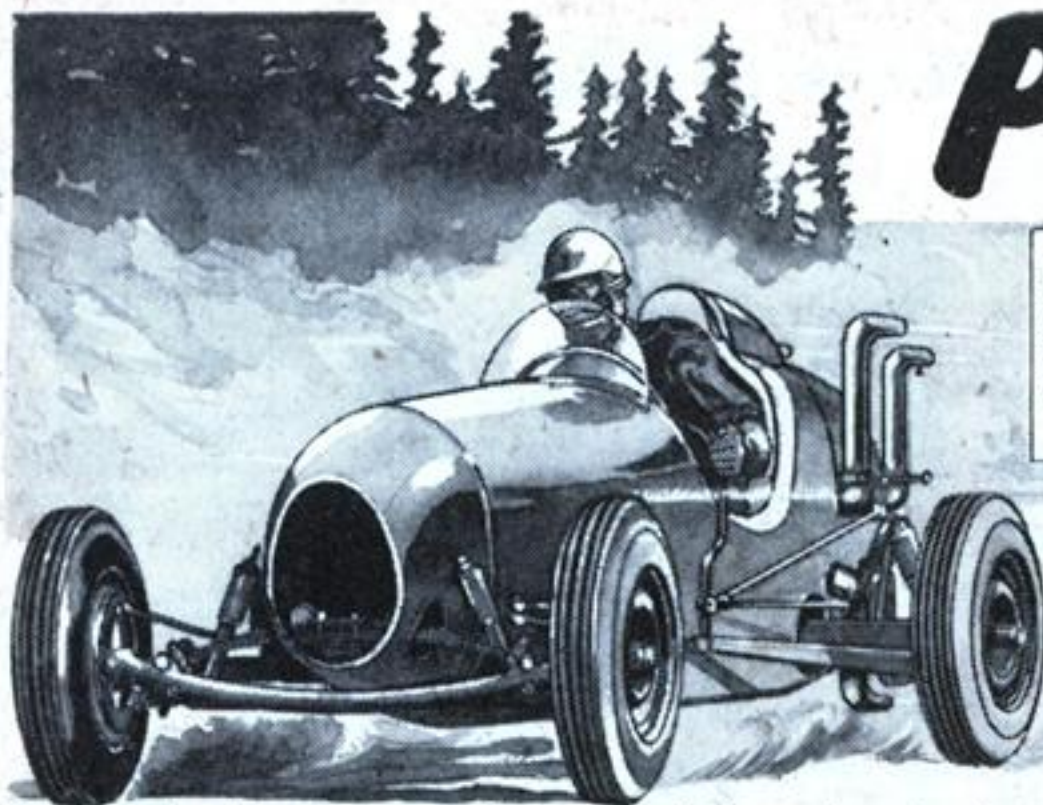
A radar mechanic explains how the terrible Arctic cold freezes lubricating oil in the radar's antenna gearing; how a single night without heat in the shack puts the radar off the air—maybe for good. He goes on to tell how antenna supports, crystallized by cold, suddenly snap. As he talks, I recall how, as a radar maintenance man myself during World War II, we'd had our hands full staying on the air, and that had been in temperate climates. Today's radars are vastly refined over the 1942-46 models, but they still have "bugs" and they still go unexpectedly out of whack.

"Suppose it's the crucial day, and you're broken down?" I asked. The radar mechanic



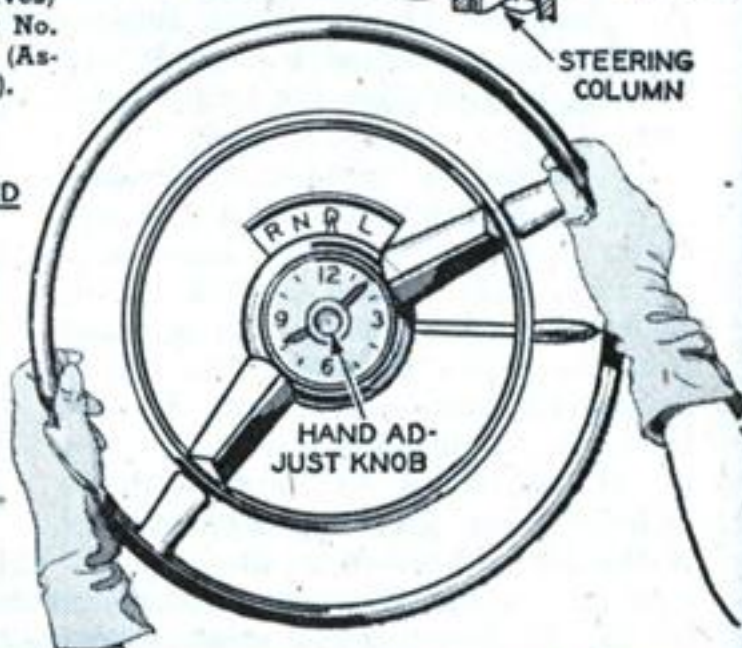
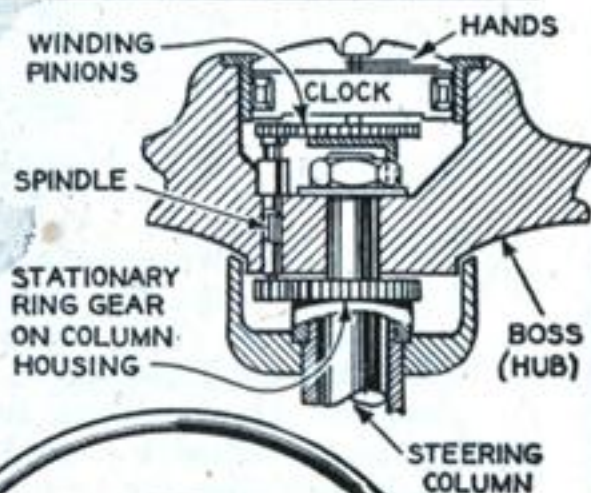
Radar installation, similar to those used in the network along the Alaskan coast, on which \$295,000,000 has been spent so far, just to buy one precious hour of warning. Each of these "eyes" that guard America is highly vulnerable to attack. Only one bomb, rightly placed, could put a station out of operation—perhaps permanently.

Patent



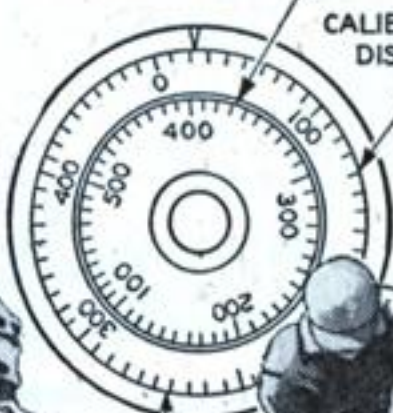
Racing Booster Jets. These swivelling nozzles, jetting engine exhaust gas backward and laterally (opposing centrifugal force on curves) will boost racing-car power up to 10%, says the inventor. Patent No. 2,724,450, Reinhold G. Kamps, Stuttgart-Bad Cannstatt, Germany (Assignor to Daimler-Benz, A.G., Stuttgart-Unterturkheim, Germany).

• For more complete information on any of the inventions shown here, you may order copies of each original patent by sending your request with the patent number to Commissioner of Patents, Department of Commerce, Washington 25, D. C. Enclose 25¢ in cash for each patent.



Clock Wound by Steering Wheel. Turning the steering wheel winds this clock. And it's safe, too, since it only takes a glance at the wheel hub in order to tell the time. Patent No. 2,699,034, Georges Maire, Tavannes, Switzerland (Assignor to Tavannes Watch Co., S.A., Tavannes, Switzerland).

CALIBRATED UNPLAYED DISTANCE DIAL
CALIBRATED PLAYED DISTANCE DIAL



YARDAGE INDICATOR



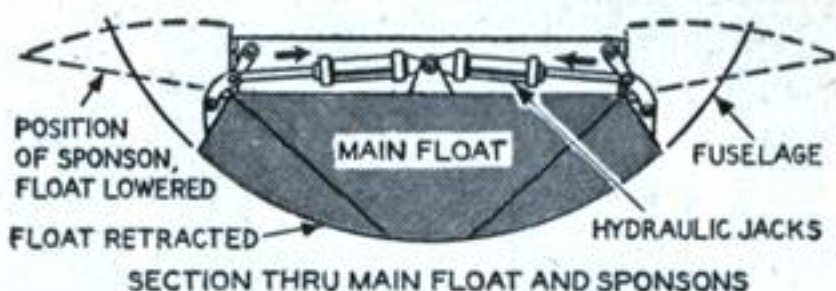
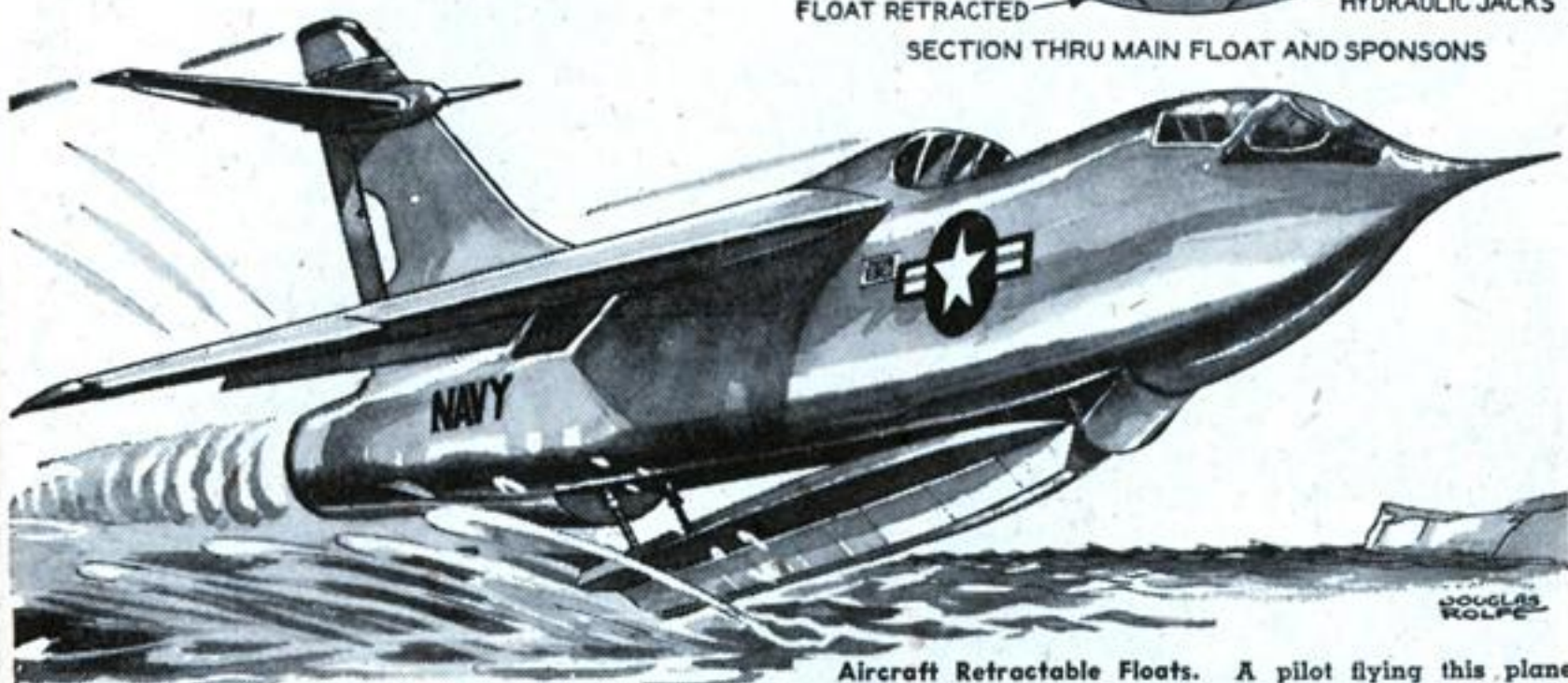
CAM

Golf Cart Odometer. Cam action off a wheel on this golf cart gages your travel on the links. Played and unplayed distances between holes are shown. Patent No. 2,711,027, Norman Bruce Williamson, Portland, Oregon (Assignor to Jarman-Williamson Co., Oregon).

Portable Air Conditioner. Stash this unit in your car or cabin cruiser; move it around the house; take it along to hotels and motels. Runs on battery too. Patent No. 2,749,725, Eldon F. Essman et al, Dubuque, Iowa (Assignors to Eska Company, Dubuque, Iowa).



Parade



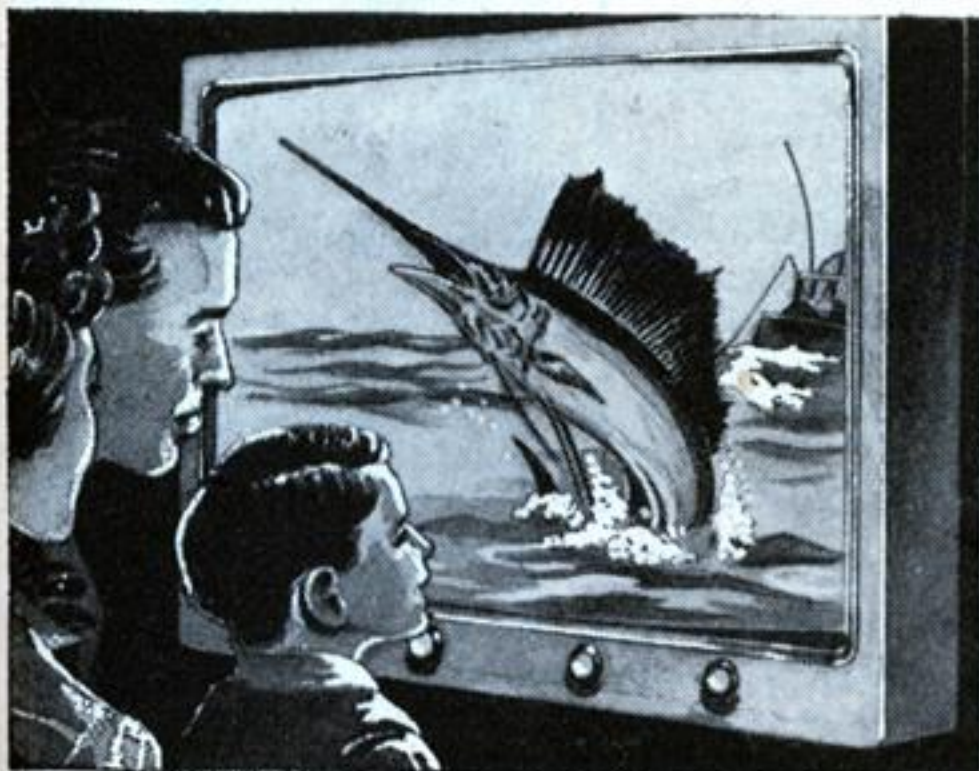
Aircraft Retractable Floats. A pilot flying this plane equipped with its fully retractable float can land and take off from water with greater safety since the ship is more fully streamlined than standard fixed-float sea planes. Side floats or sponsons lift as stabilizing planing surfaces. Patent No. 2,753,135, Arthur Gouge, East Cowes, Isle of Wight (Assignor to Saunders-Roe, Ltd., Osborne, Isle of Wight, England).



Dispenser for Shoe Non-Skid Tape. This tape for preventing falls in icy weather comes in a roll with sole and heel lengths readily marked off for tearing at the perforations. The walking side of the tape is abrasive; the other side has an adhesive coating for sticking to your soles and heels. Patent No. 2,732,085, Andrew S. Marchese, Brooklyn, N.Y.



Pocketbook Fan. Stay cool wherever you are with this miniature blower. One flashlight battery runs it. Blades hang folded at rest; spinning fans them out. Cover comes off top, fits onto bottom during use. Patent No. 2,750,104, C. Scaroulis, New York, N. Y.



Picture-Window TV. Ionizing gases and control electrodes operate this mural screen which hangs on any wall. Patent No. 2,760,119, P. G. Toulon, New York, N.Y. (Assignor to Products and Licensing Corp., Greenwich, Conn., and Nelson Moore and William D. Hall).

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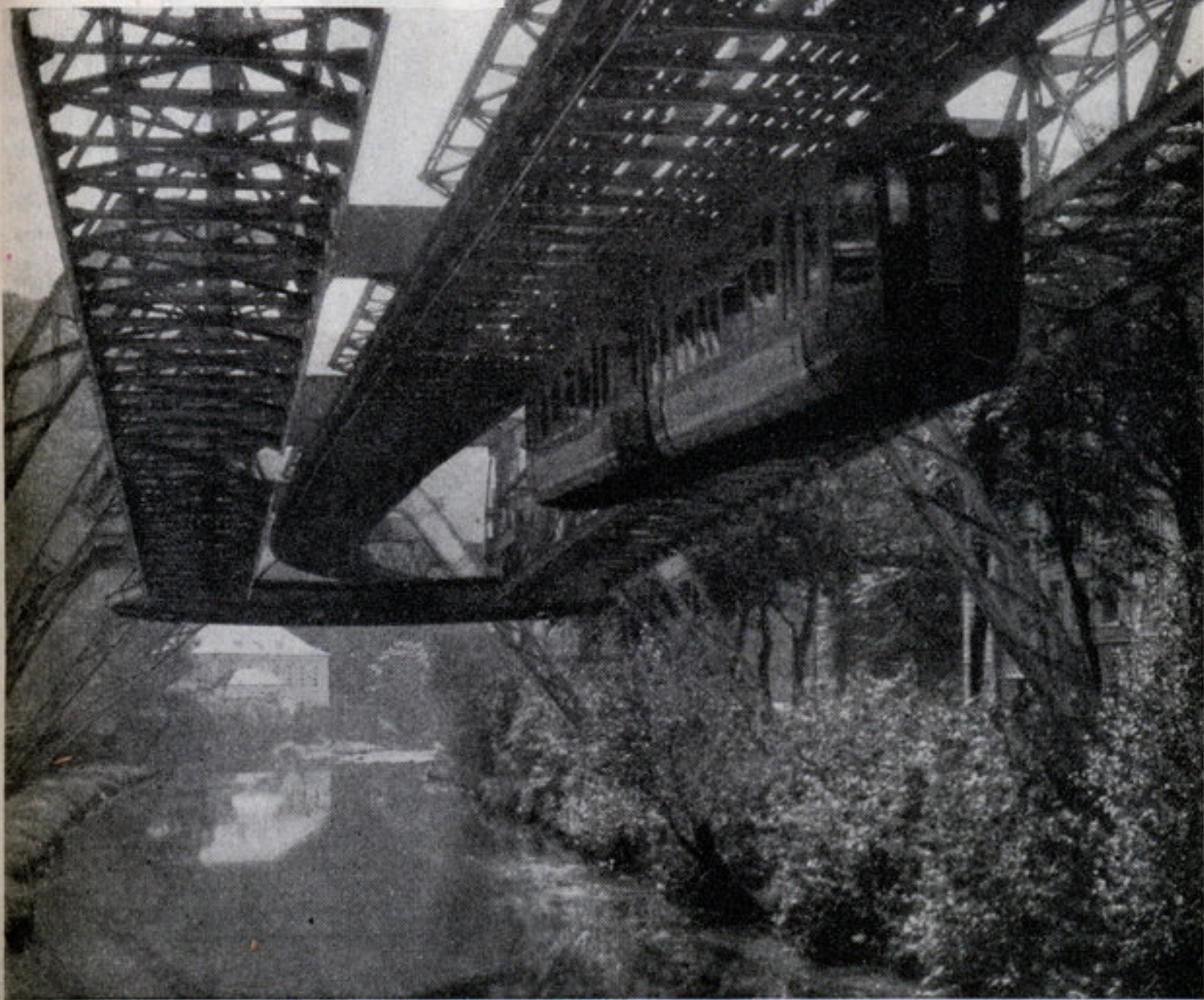


MONORAIL
Comes of Age

SCIENCE and MECHANICS

The Magazine That Shows You How

FEBRUARY, 1946



Ewing Galloway photo

MONORAIL Comes of Age

By PHIL GLANZER

IMAGINE boarding a sleek, gleaming car and speeding to your office or home at 200 miles an hour—noiselessly and without a jar!

Imagine living out in the wide open spaces where you've always wanted to live, away from the crowds and smoke and noise of cities—even

The printer didn't get this picture turned wrong way up. What you see is a monorail train at Elberfeld, in Germany. The train runs under, not over, its elevated track.

a hundred miles distant from your work, yet only a half-hour commuting-time away.

Imagine crossing the continent in nine hours at 300 miles an hour, at a cost of not more than a cent a mile!

Does all that sound fantastic? Perhaps. But in the not-too-distant future you may be able to do just those things. You may be able to climb aboard a projectile-like train in San Francisco at say, 8 a.m., and eat dinner in New York!

No, these are not dreams. They are the sound



Here the monorail, still following the river, runs through the city. Surface roads are left free for motor traffic. Even the elevated structure that supports the monorail avoids the city streets.

Ewing Galloway photo

any other form of railway yet devised. Constructed on scientific lines, it is a system which eliminates the possibility of derailment and makes for the greatest speed obtainable with comfort, safety and economy."

Monorail is not new, by any means. Europe has used it for many years and proved every claim made for it by engineers the world over. Glance at the record of a monorail line between Elberfeld and Vowinkel, in Germany.

Constructed in 1901, this line is today prac-

predictions of a group of engineers and industrialists who hold one of the most gigantic and thrilling of all post-war projects in their hands.

What is this project? Monorail. It is said to head the list on Washington's startling agenda of after-war enterprises. Recently, former U. S. Secretary of the Treasury Henry Morgenthau said: "Monorail looks like the best single buffer against post-war depression that has come to my attention."

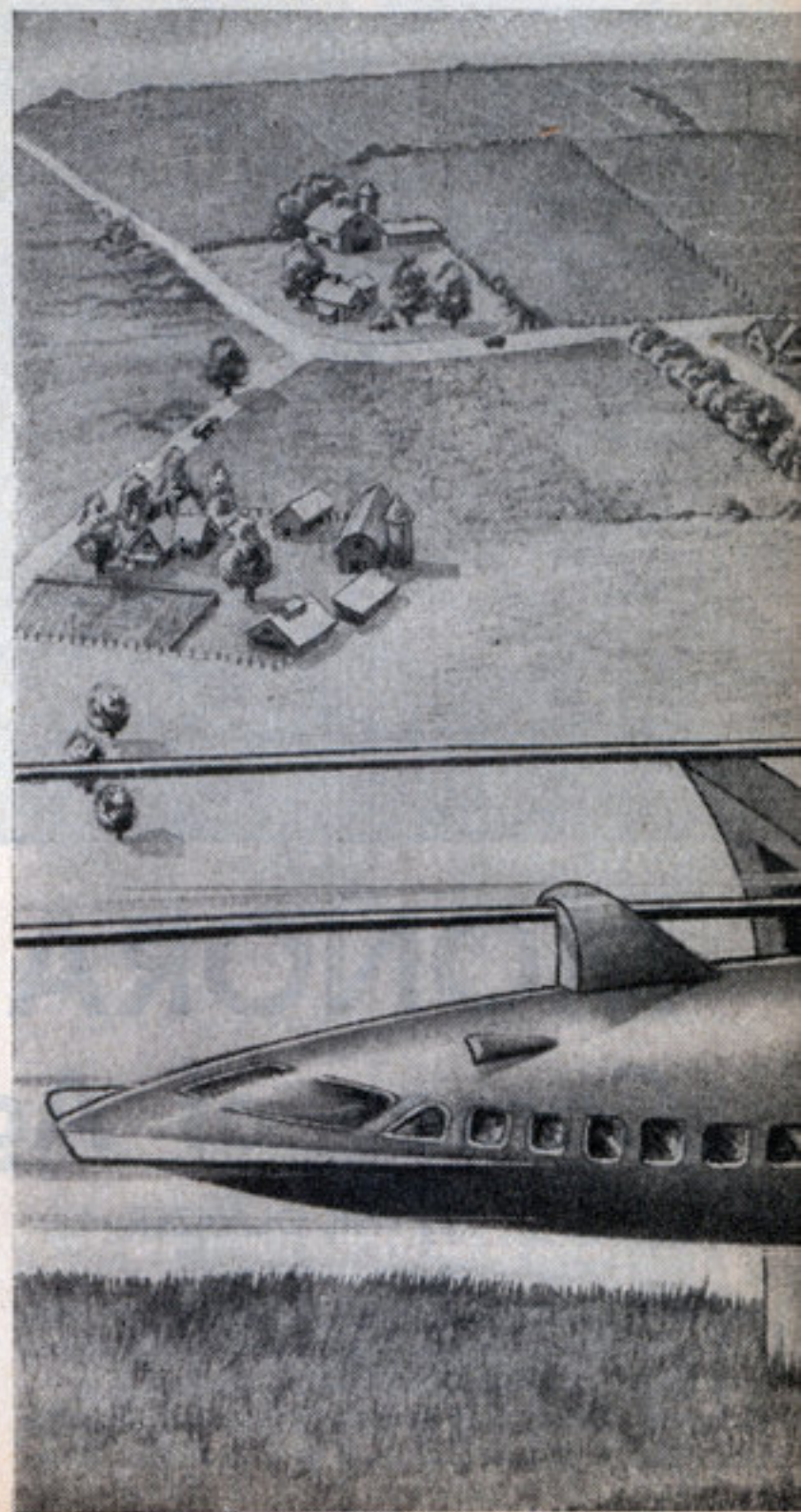
Monorail would solve many problems of the post-war period. Primarily, it would solve the urban transit problem, one of our cities' biggest headaches because of congested traffic conditions. It would also solve the problem of living too far from work. A hundred miles by monorail is comparable to 20 miles by existing methods of transportation.

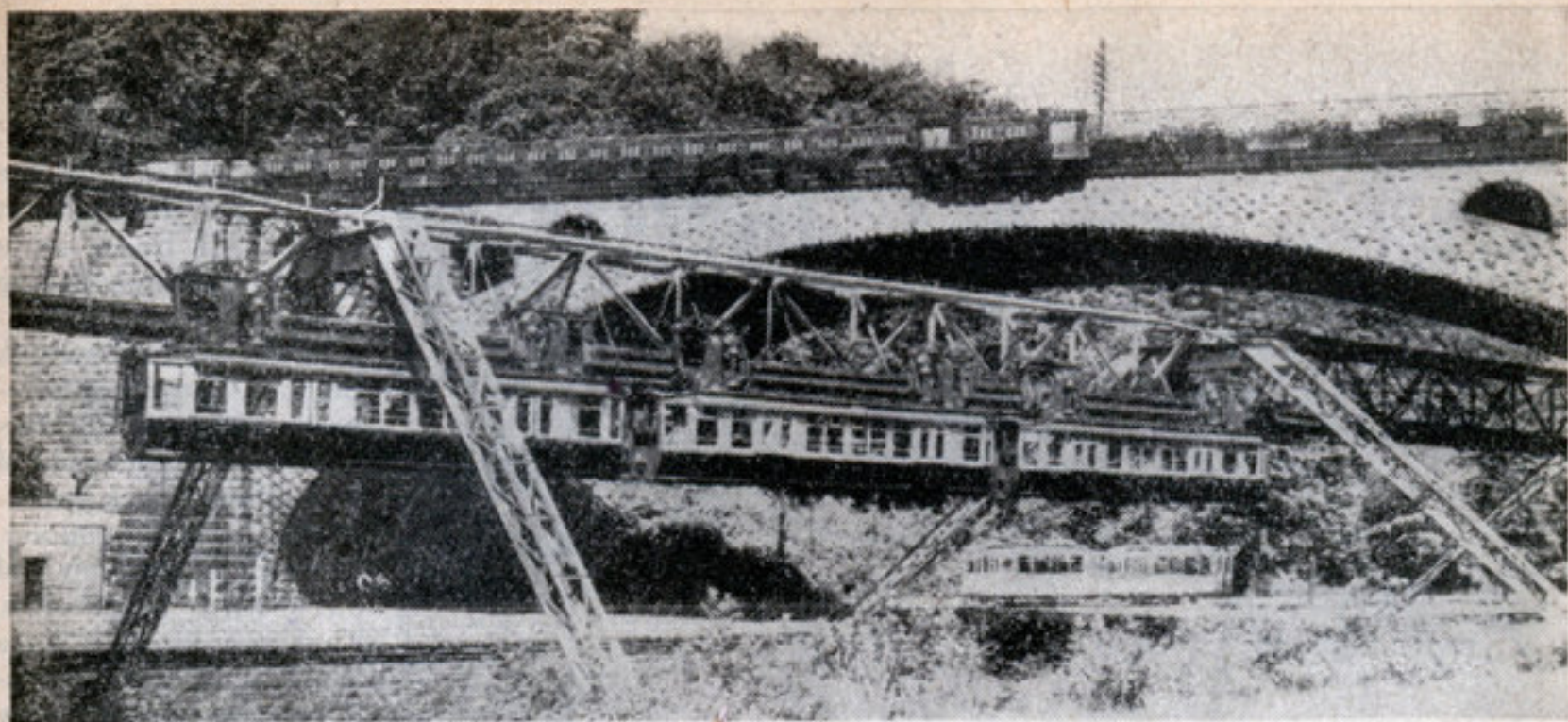
But there is another vastly important angle to monorail—post-war employment. Victory itself brings a new crisis and a new challenge to America, a challenge to provide jobs not only for the millions in the armed services, but also for the men and women once employed in war production.

Monorail is at the top as far as potential manpower requirements are concerned. It's at the top in the matter of utilization of vital commodities—steel, iron, cement, copper, aluminum, plastics, electrical supplies.

Briefly, monorail is a single steel rail suspended on rigid standards set in the earth. Its cars hang suspended from wheels riding on this rail. Of the operation of this unique transportation system, the Encyclopedia Americana says:

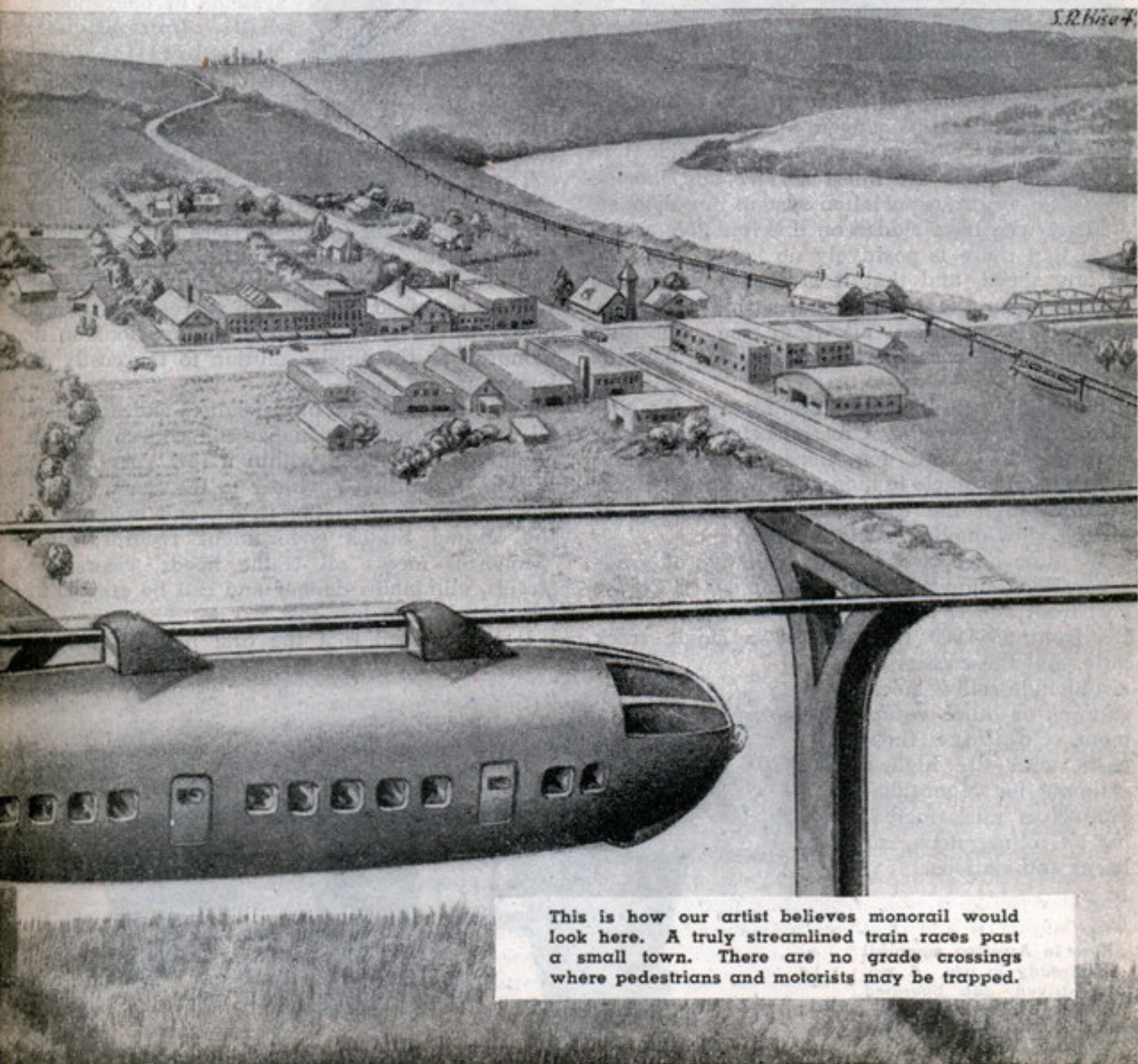
"In all the various applications of Monorail, it has been fully demonstrated to the satisfaction of the world's most eminent engineers that for speed, comfort, safety and economy, it excels



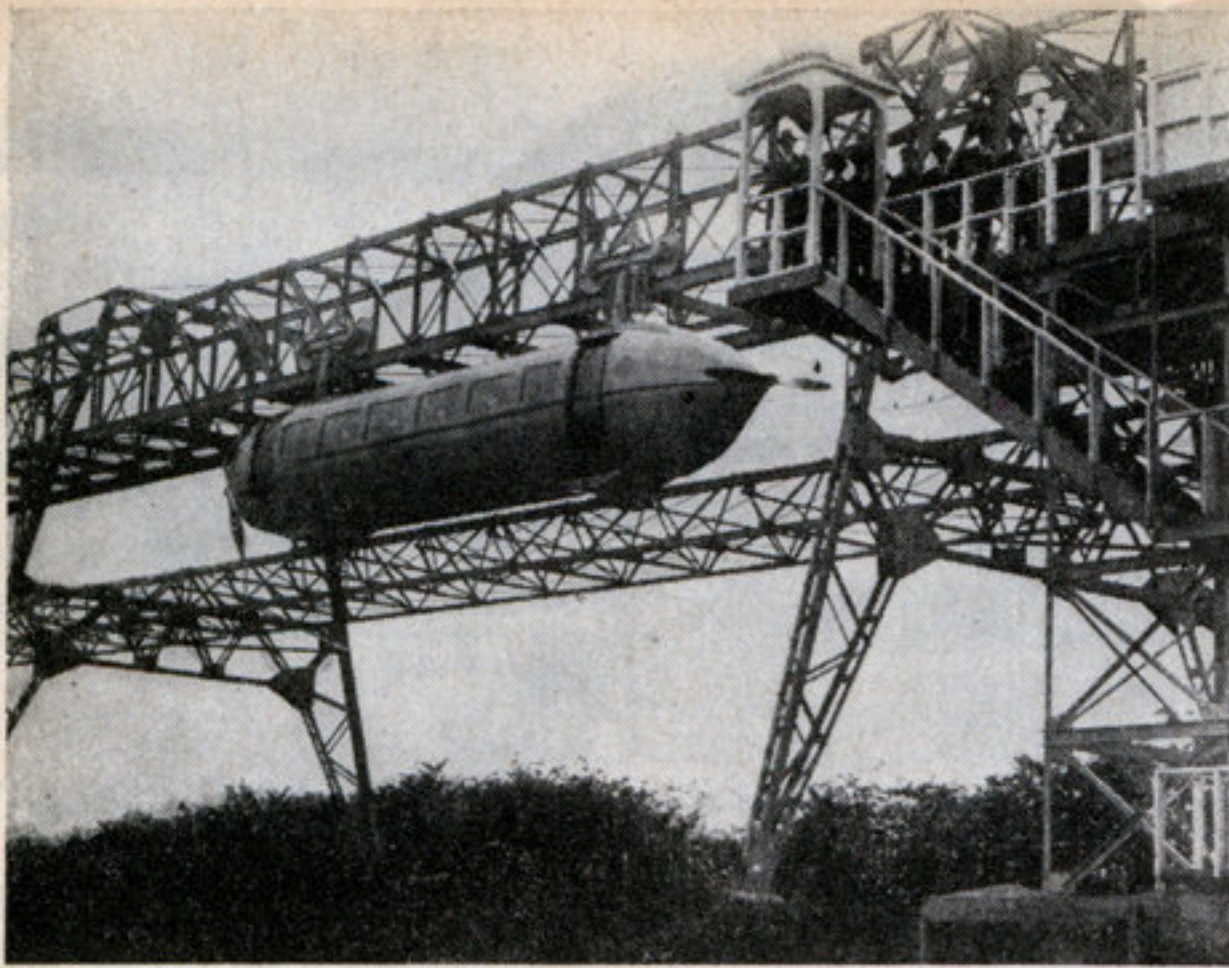


Ewing Galloway photo

A three-car train runs between Elberfeld and Bremen. With 20 station stops, this monorail travels more than 8 miles in 30 minutes. The capacity of one car is 75 passengers. City bus lines can't do as well.



This is how our artist believes monorail would look here. A truly streamlined train races past a small town. There are no grade crossings where pedestrians and motorists may be trapped.



Scotland uses monorail now. This bomb-shaped car supplies rapid transportation at Glasgow.

tically an antique, yet it has carried over more than a half billion passengers at speeds up to 125 miles an hour without a single fatal accident to anyone. It holds the finest service and income record of any transportation system in existence.

Many who have ridden on this line give assurance that there is positively no jar or vibration at any speed, and that it is almost impossible to tell when the train speeds around a curve, since its suspension, allowing free pendulum movement of cars, permits automatic banking on turns.

Monorail cars literally "fly through the air" above surface traffic. Cross-streets, peak hour crowds, snow, rain, fog—none of these things presents an obstacle to monorail. You must either bore through the earth or move above it to escape slow-moving surface traffic.

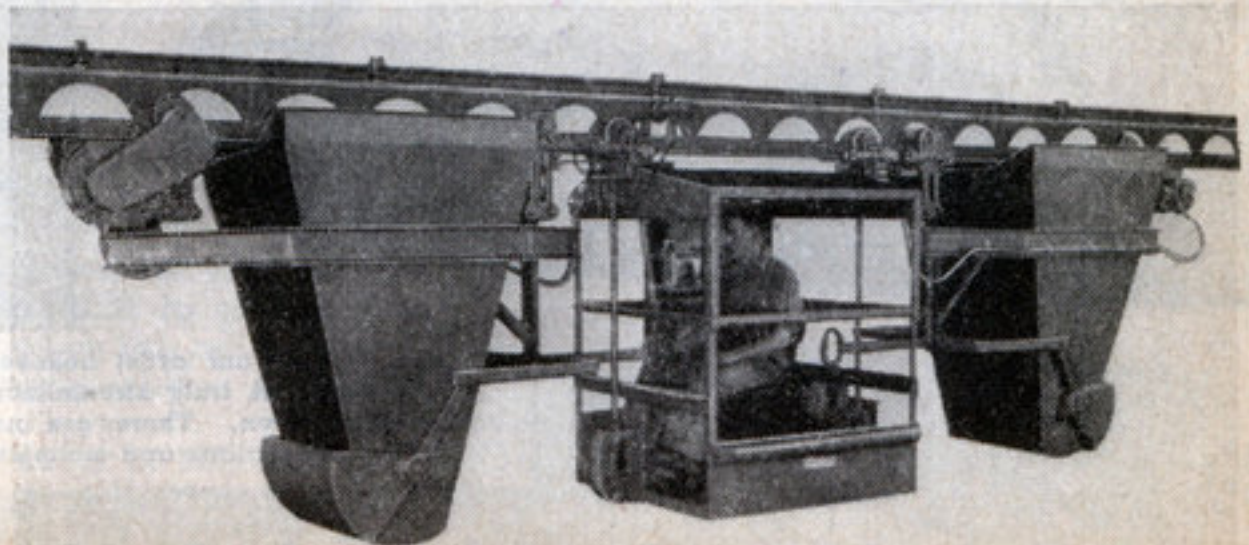
We now have two existing methods of grade separation—subways and elevateds. Subways cost from 3 to 11 million dollars a bore mile, and L's from \$866,000 to \$1,118,000 a single track mile, and these costs do not include rolling stock, stations or other equipment. Compare those costs with the highest estimate for Monorail—\$280,000 a mile, including all rolling stock, car barns and stations.

dangerous to their investments. Motorcar makers have always frowned upon steam, or any other form of automotive power, for the same reason.

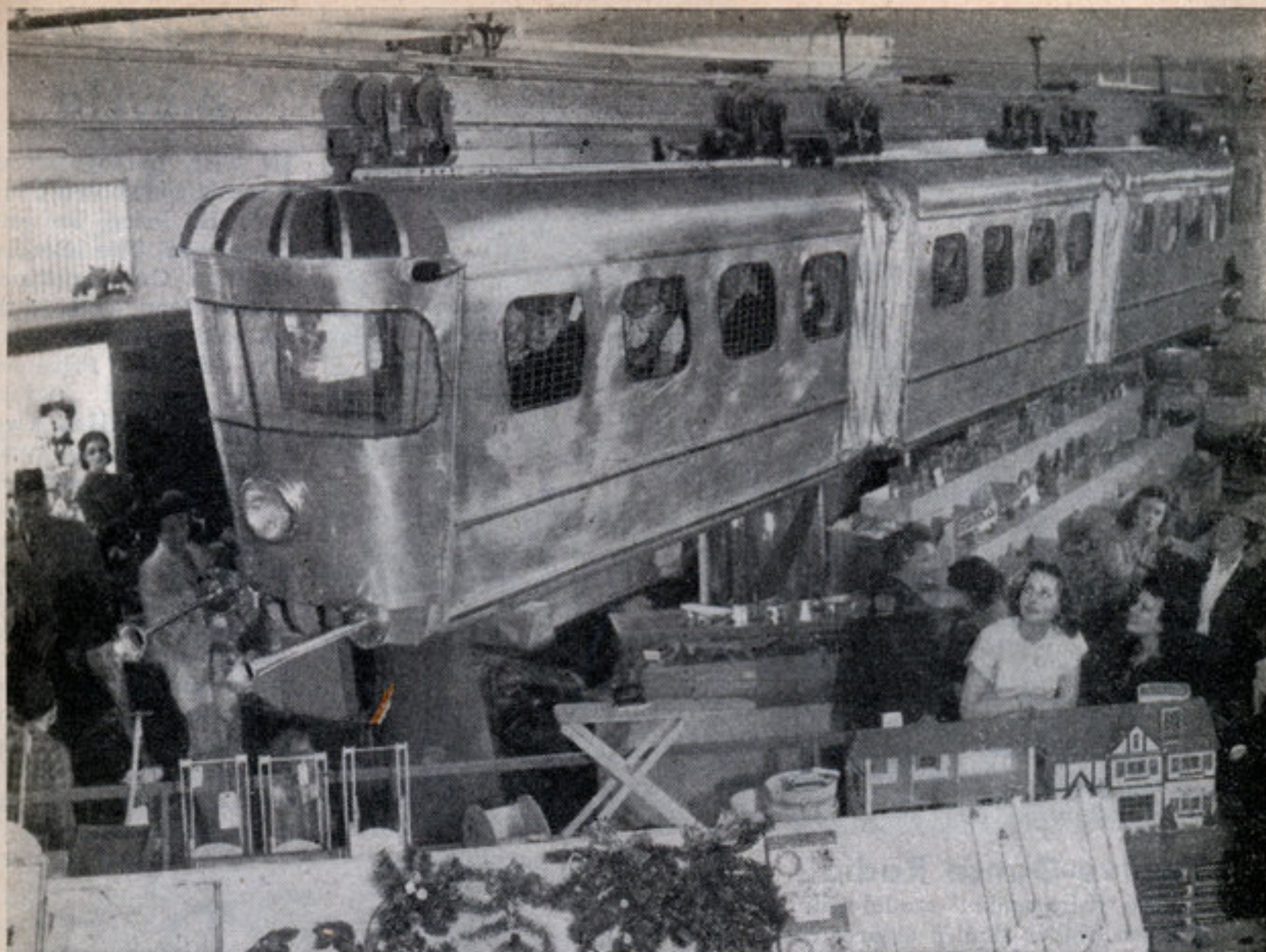
There is one answer. But conditions are now changed. The demands of war and the resulting overloading of all public carriers have worn out thousands of cars and countless miles of roadbed. To replace these items, billions of dollars will be required. So it is no secret that several big railroads and electric lines are looking to monorail as the single solution to the costly dilemma facing them.

Famous engineers, industrialists and financiers all over the world visualize the widespread use of monorail systems within a few years. Zara Witkin, consulting engineer to the Soviet Union government construction trust, and engineer of the United States government records, says: "Monorail meets all traffic needs, clears the streets, eliminates danger and can be erected in less time and at less cost."

It is proposed that the first line be built in



Here in America monorail is already in use. A motor driven, cab operated double bucket carrier has been developed by the Cleveland Crane & Engineering Company.



In a Milwaukee department store at Christmas time, children toured the toy counters in a miniature monorail train. They saw everything—and eased the holiday traffic jam.

California, between Los Angeles and Long Beach—a distance of 30 miles through some of the heaviest traffic in America. Unless you fly it today, you'll spend a full hour making the trip. Monorail will do it in 15 minutes!

We're going to build a transcontinental line, too, engineers say. At an estimated cost of about 800 million dollars a monorail can be built utilizing the right-of-way of the Southern Pacific and Illinois Central Lines. This line will touch most of the important cities across the country, and bring the coasts within 10 hours of each other—at a transportation cost of less than one-fourth of air transport rates!

Monorail is noiseless in operation because its drive wheels have no flanges and there is no side-thrust—the two unavoidable features that cause the clatter and jolting of surface rail cars.

The safety factors of monorail are not approached in any other vehicle. Surface trains can jump the track, collide with other trains, and run through open switches. Monorail cannot be derailed, according to its backers. A block signal and braking system, controlled by electronics, are said to make collisions impossible.

Monorail becomes the first dimension in the decentralization of the cities of the future. It means more than that. A rapid transportation system to outlying districts would bring about the sale of real estate now lying dormant, which

in turn would bring about an improvement in the morale of householders and create a property owner and taxpayer out of many a transient tenant.

From the standpoint of public benefit, monorail is at the top. A cursory survey covering all the cities of the United States with a population of more than 100,000 inhabitants, indicates a potential demand for 7,390 monorail cars. This is based on one car for each 10,000 inhabitants. At an estimated cost of \$20,000 a car, this represents 147 million dollars in the car-building business alone!

Assuming that four miles of twin track will be required for each car, a total of 29,560 miles of track will be needed. At a cost of \$280,000 a mile, we reach the astonishing figure of \$8,276,800,000—a vast number of manhours in any employer's language!

Monorail is not expected to jeopardize the financial position of any existing surface transportation system. It is public knowledge that before the war almost every urban transit line was operating at a loss. Now they have to spend millions repairing roadbeds and worn-out equipment. Present urban lines can be used for short hauls and as feeder lines to the monorail stations, which will speed up traffic, help to reduce accidents and expedite the progress of fire and police apparatus, backers of the scheme assert.

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Science and Mechanics

HUGO GERNSBACK
EDITOR

The Flame Tank

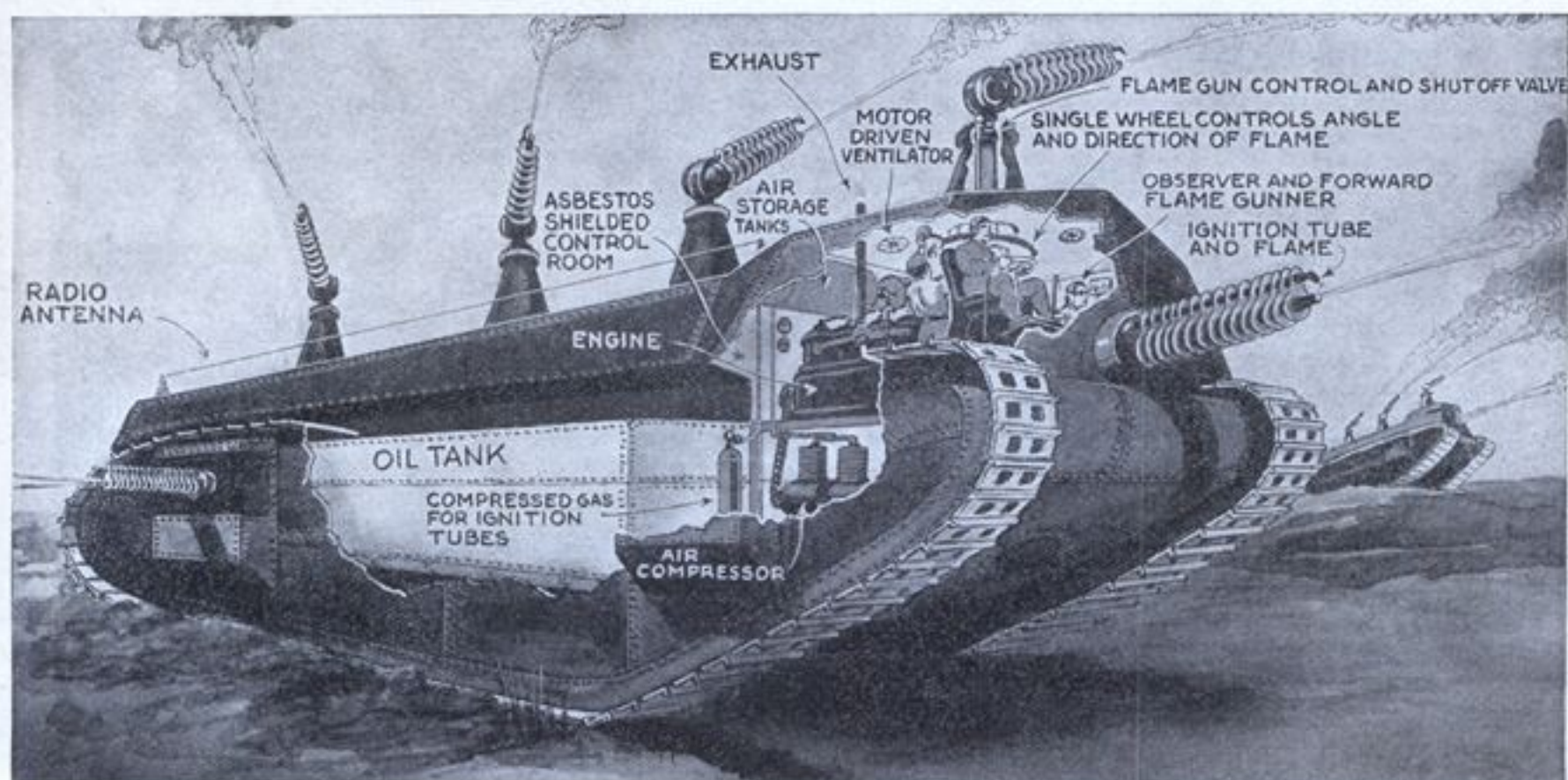
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NEW IDEAS ★ PRIZE CONTESTS ★ PRACTICAL HOME HINTS ★ MONEY-MAKING PLANS
POPULAR EXPERIMENTS ★ LATEST INVENTIONS ★ WOOD AND METAL WORKING

The Flame Tank

By HUGO
GERNSBACK



Cut-away view, showing the interior arrangement of the flame tank, a proposed new engine of war, but useful also in the arts of peace, when necessary to clear large areas of ground. The flaming liquid can be thrown to great distances, under control of the operating crew.



The stream of liquid flame thrown from a one-man portable flammenwerfer during a test. Observe figure at right.



Italian flame throwing unit in fireproof suits, with their tanks and nozzles.

● LAYMEN still labor under the erroneous conception that war is far more frightful in modern times, and that it kills more of the combatants than formerly. Quite the contrary is true. In ancient war, when hand-to-hand fighting was the order of the day, as, for instance, in the old Roman times, casualties were far and away greater than they are in modern warfare. Close fighting with swords and other hand operated weapons wrought terrific havoc. Not only that, but, even if a soldier were only slightly wounded, he often died of infection. In other words, even if you weren't killed outright, and were only slightly wounded, the chances

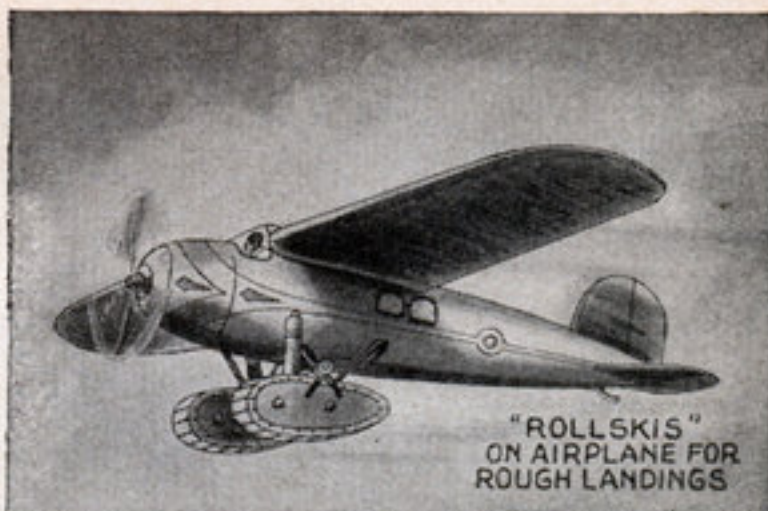
were all against your recovery. The reason for this is that, in the old days, there was no such thing as an organized Red Cross movement or even intelligent medical care of the wounded.

In modern war, where armies fight further and further apart, war becomes less brutal, and the wounded have a better chance of recovery. Of course, there is still close fighting at times but, in general, it happens only occasionally and is not the general order of the day. Modern war tactics demand mobility of the opposing factions, and they often do not get within miles of each other. Only when the enemy digs itself in, with earthworks and trenches, does close fighting again become necessary. If means are found to threaten the extermination of the men in the trenches, it will be found that they quickly abandon the trenches as untenable. This means that much less slaughter will be required; because the enemy will retire when he knows the odds are overwhelmingly against his holding his position.

The flame tank, which I present herewith as a new idea in warfare, is not—as it would appear on first
(Cont. on page 34)

Rubber-Footed Vehicles

For Land, Water and Air, to Make Exploring Safer and Easier, and Develop Rugged Country.



The rubber landing surfaces will, it is claimed, prevent crackups by keeping the plane in steady motion till it stops.

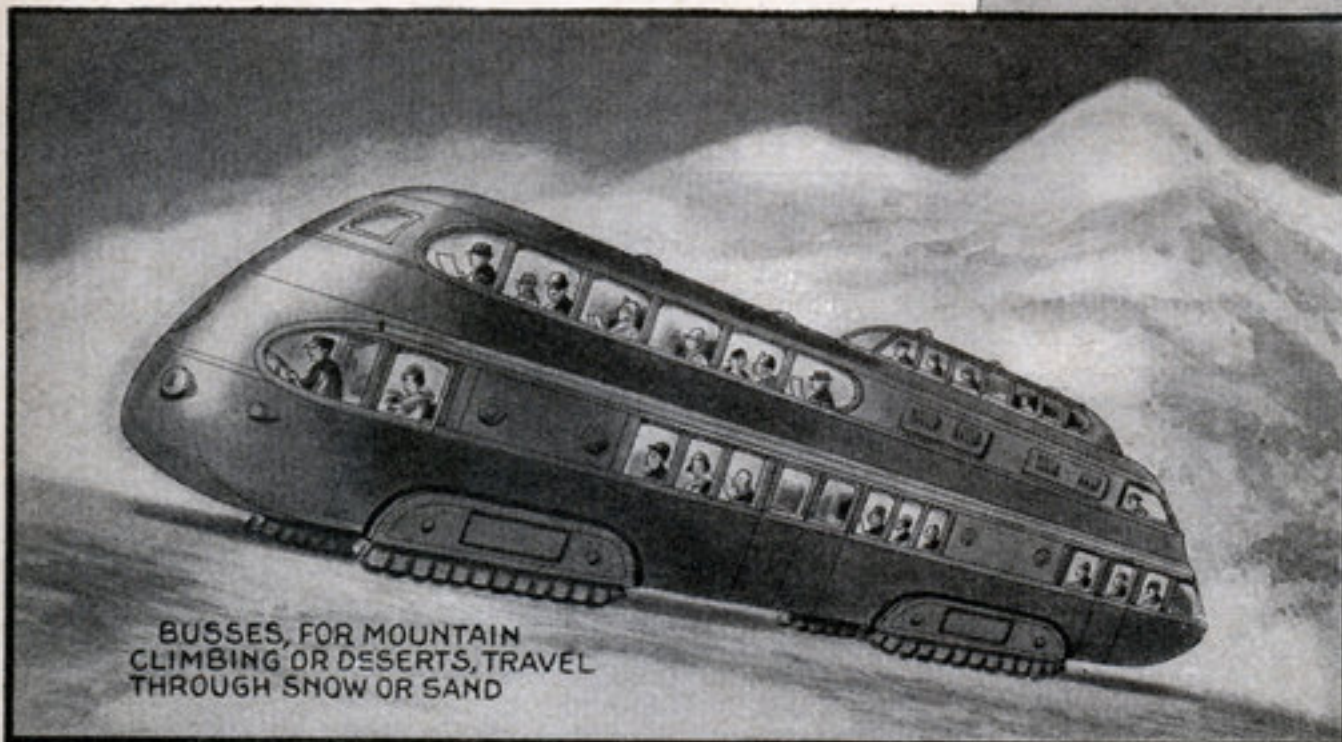
rear caterpillar drive.

Yet the caterpillar, at a high speed, would be quite destructive to any ordinary road, with its iron pedals; and a new device, as here illustrated, is now in use (in Switzerland) to combine the best features of both methods. The moving belt of the caterpillar is armed with solid rubber cushions which grip the ground firmly, distribute the pressure, and eliminate the shock and noise (which soldiers might disregard, in a tank, but not ordinary passengers).

Cars of this type have been used to climb Mont Blanc, the St. Gothard, and other lofty mountains, and it is stated that wider commercial distribution is to be undertaken.

It is also suggested that such a car as that illustrated below, capable of going over land and through water, would be useful in exploring new countries, where roads are lacking. The design, outlined by the German engineers, B. and H. von Roemer, in *Das Buch für Alle*, is strangely reminiscent of certain stories of invention which were familiar to American youth in the last decade

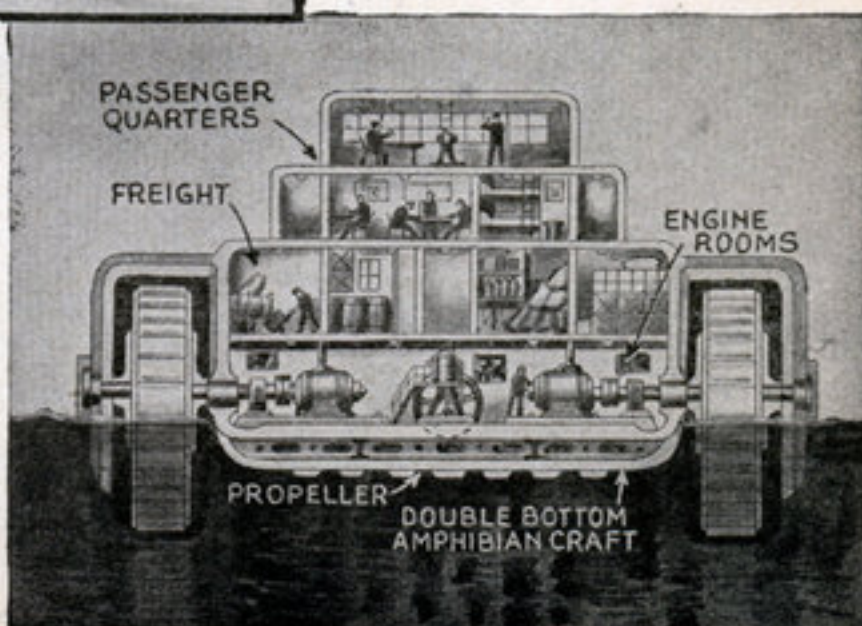
(Continued on page 254)



Rubber-footed busses are actually in use in Switzerland; and the principle, on a smaller scale, has been used to cross the Sahara and Central Asia.

● BEFORE the caterpillar truck came into extensive use, rubber feet had been in use on heavy vehicles, such as were used for artillery. The spreading of the rubber gave a wide area of contact, instead of the theoretical straight line only, in which a cylinder touches a flat surface. This saved the surface of the road, and made it possible to move much heavier weights. The caterpillar truck, distributing its weight over an even larger area of rolling iron plates, made it possible to move such huge structures as army "tanks" over rough country, and through a battlefield cut up by trenches, where wheels would be quite useless. Another combination has front steering wheels and

At the right, a proposed vehicle, for exploration where there are no roads, capable of crossing rivers and swamps.



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Visible Sounds Put to Use

(Continued from page 220)

the lines or spots of the sound pattern. We may use water instead of powder, if we like. One of the pictures shows water thrown into a very fine spray by the vibration of the vessel in which it is contained. In a closed tube, like an organ pipe, there are methods of measuring the vibrations of the mass of air, but this is more difficult.

An interesting subject, in connection with this, is the problem of making a loud-speaker cone or diaphragm "distortionless," that is, so that it will give out only sounds corresponding to the current fed into it. If the cone or diaphragm were absolutely rigid, the only air vibrations it could cause would be those corresponding to the motion of its armature or coil. But no cone is absolutely rigid; and the more rapidly one is moved as a whole, the more it bends upon itself, and the more harmonics it introduces into the reproduction. The smaller the cone, the less this bending; so that the dynamic speaker, with considerable power, and a small, fairly stiff cone, has become the most approved type.

However, while a loud-speaker cone which is vibrating or "fluttering" in other directions from the motion of its driving pin, can only spoil reception by adding a few high notes, in high-speed machinery more costly troubles can be encountered. One of our pictures shows the fragments of a steam-turbine blade, shattered by its own vibrations which, when sufficiently continued, disrupted the metal. Another picture shows a blade being tested for its vibrations by an electric apparatus which keeps it in motion at its natural frequency of 217 vibrations a second. It is seen that the metal is vibrating least on the lines from the center out toward the rim holes, and most between the latter.

The upper pictures on the first page of this article show a violin body tested with three different notes to determine its response to them. The sand figures formed on the back and belly of the instrument, even before it is put together, serve to guide the violinmaker as to the tone of the instrument. It will be seen that, as the pitch of the note rises (from left to right), the sand figures become more sharply outlined.

With a telephone diaphragm, shown in one of the pictures, if the response were perfect, the powder would be distributed evenly over the surface. As a matter of fact, it forms patterns, increasing in complexity as the note goes up. A loud-speaker diaphragm may form a dozen vibrating sec-

tions, looking like a cut through a grapefruit, at high frequencies.

The principle here applied is not the same as that of the vibrating conveyor illustrated on another page, in which the system moves as a whole; in this, harmonic vibrations would simply cause slight waves in the progress of the material.

It may be asked how a sound wave progresses, when the air thrown off by the vibrating surface at each movement returns immediately. Sound is not a movement of the air from the source of sound to the listener, but a slight change in the direction of the particles of air, which are always in motion, back and forth, at a speed which is about 1640 feet a second. The bouncing particles (or molecules), hitting each other like a row of swinging weights, transmit an impulse, each one to the next, which is a little harder on the side from which the sound comes; and this impulse—the actual "sound wave"—travels at about two-thirds the average "molecular speed," or just under 1100 feet a second.

The velocity of sound, in different substances, has been measured; it is fifteen or sixteen times as great in iron as in air. If we rap on an iron pipe, the sound will be heard almost instantly through the metal, while it will take an appreciable time to travel through the air to the other end. Glass and aluminum are perhaps even more rapid sound transmitters. Water carries sound four times more rapidly than air, and much more powerfully, because the sound waves are not as free to spread out. In an atmosphere of hydrogen, sounds would be heard four times more quickly; in one of a heavy gas, like chlorine, more slowly. And, if rubber would carry sounds so far, we could hear an echo from a long bar of rubber struck with a mallet long after the noise in the air had died away; because the speed of sound in rubber is one sixth what it is in air.

Rubber-Footed Vehicles

(Continued from page 217)

of the Nineteenth Century—those about Jack Wright and Frank Reade. The greatest difficulty, however, would be that of power. We might suppose an explorer's vehicle equipped with gas and wood-alcohol producers, utilizing wood for fuel—as this is available where petroleum is not.

Wood Plastic for Many Uses

(Continued from page 243)

built-up pieces of special shape; for example a piece of molding to replace a broken part (Fig. 9).

Articles can be built up entirely from plastic wood. In such cases it is usual to build the article in a series of successive layers, allowing each layer to harden before applying the next one. In the case of large or bulky articles it is better, however, to use some sort of a core or foundation of ordinary wood, for the same reason as that previously mentioned and illustrated in Figs. 2 and 9.

The method of building up objects with plastic wood is particularly useful in making patterns with projections, such as gear-wheel teeth, valves, bushes, patterns for plaster casts and ornamental purposes,

brackets, etc. (Fig. 5). Curves, to round off angles or joints between flat surfaces, can be made. A good method of making such fillets is to apply the material as uniformly as possible along the angle; and, just when it commences to harden, to draw a ball of the required diameter, mounted on a handle (Fig. 7), along the corner. This will leave a uniform smooth fillet right along.

Surface defects, such as those caused by the tearing away of a piece of lumber, or by a severe indentation, may be repaired with plastic wood by using rather more of the correctly tinted material than will fill the cavity, afterwards smoothing the hardened material down with a sharp chisel or plane (Fig. 8).